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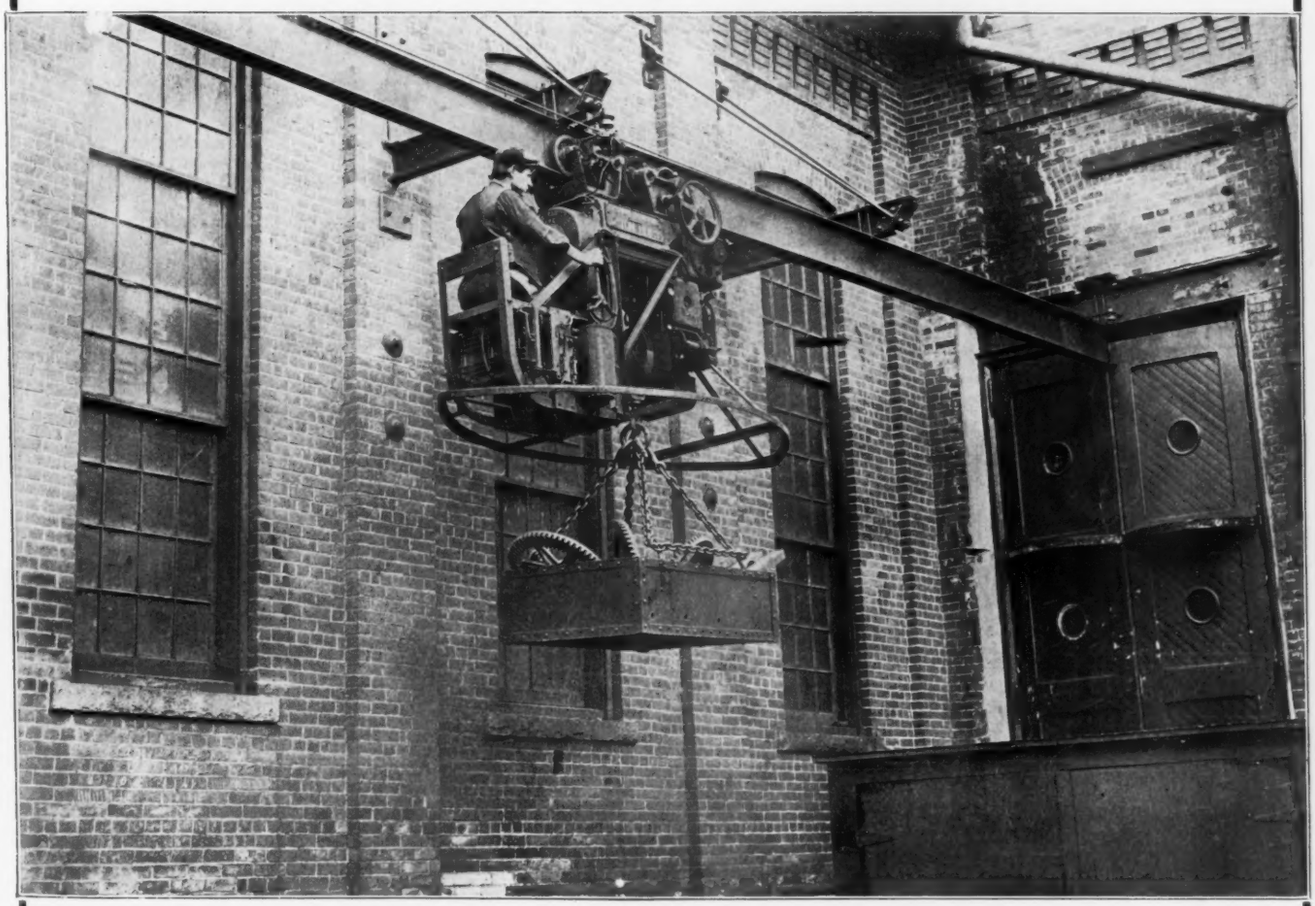

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THE FOUNDRY

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PRODUCING MALLEABLE STOVE PLATE

A description of the equipment and practice of a large stove plate foundry, in which organization and methods effect great economies

By H. Cole Estep

TO DESCRIBE a shop which turns out several thousand tons of malleable stove castings every year without the aid of a single molding machine or any of the other mechanical devices generally considered essential to an up-to-date foundry, seems at first glance to be encouraging a step backward. But a closer acquaintance with this rather unusual plant will show that it is by no means a backward institution when it comes to turning out a product of maximum value at minimum cost. If the plant under consideration is a financial success—and no one doubts that it is—without resorting to the use of labor-saving equipment, there must be something else about it which is a powerful factor in effecting economies. This something else is an intangible thing which may be roughly defined in three words—brains, methods, organization. Behind the somewhat commonplace exterior of this shop there has been a lot of thinking. Intensive, accurate thinking, after all, is as important as machines. The most elaborately equipped plant will be a failure without some use of brains, methods and organization, but where brains and equipment have been combined we have witnessed phenomenal successes. Over-equipment is as great an evil as the insufficient use of labor-saving machinery. In general, however, foundries have suffered comparatively little from the sins of over-equipment, for foundrymen are proverbially conservative. But they have not escaped the infection by any means. The writer has seen a number of foundries equipped to melt 30 to 40 tons of gray iron a day in localities where the greatest demand for years to come will not exceed 20 tons; at present these shops are melting an average of 10 tons daily and their owners are wondering why the costs are so high. In another gray iron

FIG. 1—GENERAL VIEW OF THE MOLDING FLOOR OF THE MISSOURI MALLEABLE IRON CO.'S FOUNDRY

FIG. 2—AIR FURNACE FOR MELTING MALLEABLE IRON

shop there is a 10-ton crane ladle which has been used once in four years. A steel foundry was equipped with two 15-ton open-hearth furnaces, one of which has never been used. Another company built a new gray iron foundry for its own use in a town where the jobbing shops were so numerous that they never operated at over 70 per cent capacity, even in the most prosperous times. A shop employing seven molders installed a jarring machine with a 60-inch table and used it to ram flasks 20 inches square. These are only a few examples of over-equipment. We will now turn to the description of a shop in which careful thought combined with simple appliances is resulting in the utmost efficiency and economy.

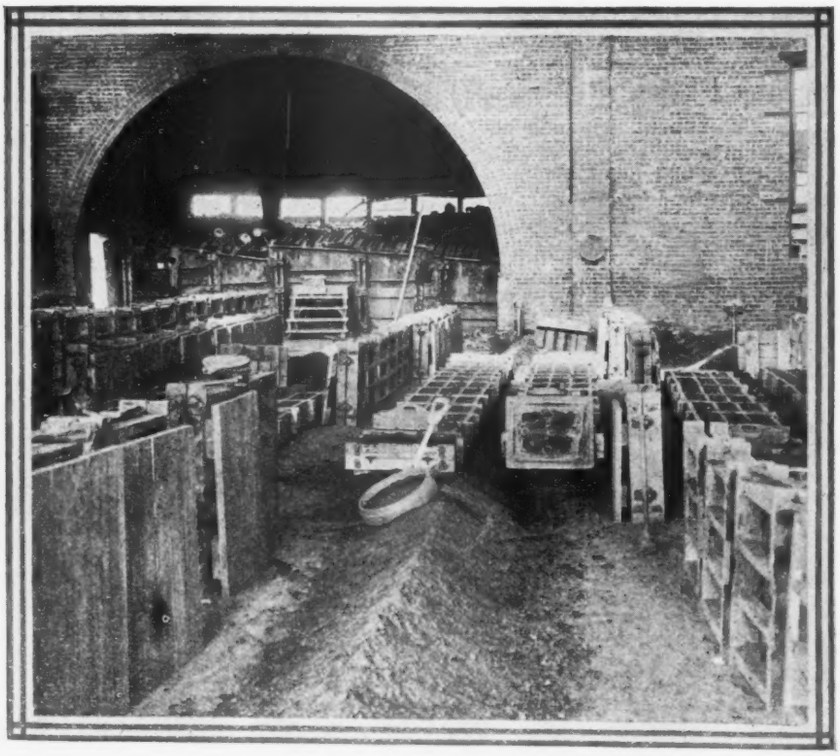


FIG. 3—ONE OF THE MOLDING FLOORS

Malleable Stove Plate Shop.

The malleable stove plate foundry of the Missouri Malleable Iron Co., at East St. Louis, Ill., is the shop under consideration. The molding floor consists of a single bay, 238 feet long and 85 feet wide. This floor is enclosed by a steel frame brick building covered with a gable roof surmounted by the usual monitor. Large windows in the side walls and monitor provide the floor with abundant light. Since only small malleable castings are produced, there are no cranes in the shop; the wall columns and roof framing are proportionately lighter. A general view of the molding floor is shown in Fig. 1. Referring to this illustration, a large arched opening may be seen in the middle of the side wall; this opening leads to a small adjacent leanto about 50 by 25 feet in size in which the air furnace is installed. At one side of the entrance to the furnace room is seen an enclosed fan which provides heated air and ventilation in cold weather. One of the small hand ladles with which the molds are poured may be seen in the immediate foreground of Fig. 1. The molding floor is lighted by six arc lamps hung from the roof trusses. Alongside the wall, shown in Fig. 1, is laid a narrow-gage track; this track enters the shop through the door shown at the extreme rear corner and passes out through a similar door, not shown, at the opposite end of the building. The track passes directly in front of the furnace and traverses the full length of the molding floor. Hand buggies running on this track are used to bring the charges to the furnace and to carry the finished castings to the annealing department.

Air Furnace.

A view of the air furnace is shown in Fig. 2. It was designed by J. P. Pero, superintendent of the Missouri Malleable Iron Co., and has a number of interesting features. The firebox is 7 feet long, 7 feet wide, 4 feet 11 inches high above the grates at the front and 3 feet 7 inches at the bridge wall. The height of bridge wall above the grates is 3 feet. The ash pit is 7 feet square and 2 feet deep. The grate area is 49 square feet. The melting hearth is 24 feet long by 7 feet wide. The furnace is connected to a brick chimney, 44 inches in diameter and 60 feet high.

The blast is furnished by several inter-connected fans and is piped from the engine room some distance away. The draft pressure usually carried is 2¼ to 2½ ounces. As shown in the illustration, the top of the furnace is drawn down considerably at the back, making a narrow throat which throws the heat onto the bath. The furnace has a capacity of from 30 to 40 tons daily. As operated at present, two seven-ton heats are taken off each 10-hour day. When firing first class Pennsylvania bituminous coal, the fuel consumption of the furnace is 600 to 700 pounds of coal per ton of iron melted; this corresponds to a melting ratio of about 1:3. The time required to melt a charge with a cold furnace is about five hours, and with a hot furnace about three and one-half hours. Repairs are made weekly. The bungs are 24 inches wide and are handled by a hand lever suspended on a chain, shown in Fig. 2. The furnace rests on concrete piers.

In charging, buggies laden with material are brought up on the track in front of the furnace; the proper bungs are removed and the charge is distributed over the hearth by hand. Owing to the manual skill employed and the care taken the percentage of loss from bad heats is very low.

Core Department.

The core department is in an adjacent building. In the core-making operations we again note the good results accruing from a combination of thought with the use of simple apparatus. A diagram of the layout of the core ovens is shown in Fig. 6. The arrangement is unique and interesting. The core buggy tracks are laid between the coremakers' benches. As fast as his green cores are finished the workman turns around and without taking a single step places them on the car, which is provided with suitable racks. The loaded cars are shoved onto the transfer table, which runs in front of the ovens and from this into the ovens; any care may be placed in any oven. Cars containing baked cores are run off on the curved track, shown in Fig. 6, and unloaded. By a proper distribution of the flues, the temperature is the same in any part of a given oven; many core ovens, on account of poor flue arrangement, are hot at the bottom and cold at the top. The advantages of uniform heat may be readily appreciated.

Add to the foregoing appliances a stock of good wooden flasks, follow boards, clamps, metal patterns and small tools and the result is practically a complete inventory of the equipment of this shop. It is by no means elaborate, but it is sufficient to get results. The air furnace and core room appliances are the result of careful thought and are well designed; each flask and piece of small equipment is designed to do its work to best advantage and was also a matter of careful thought. All the apparatus is kept in first class condition.

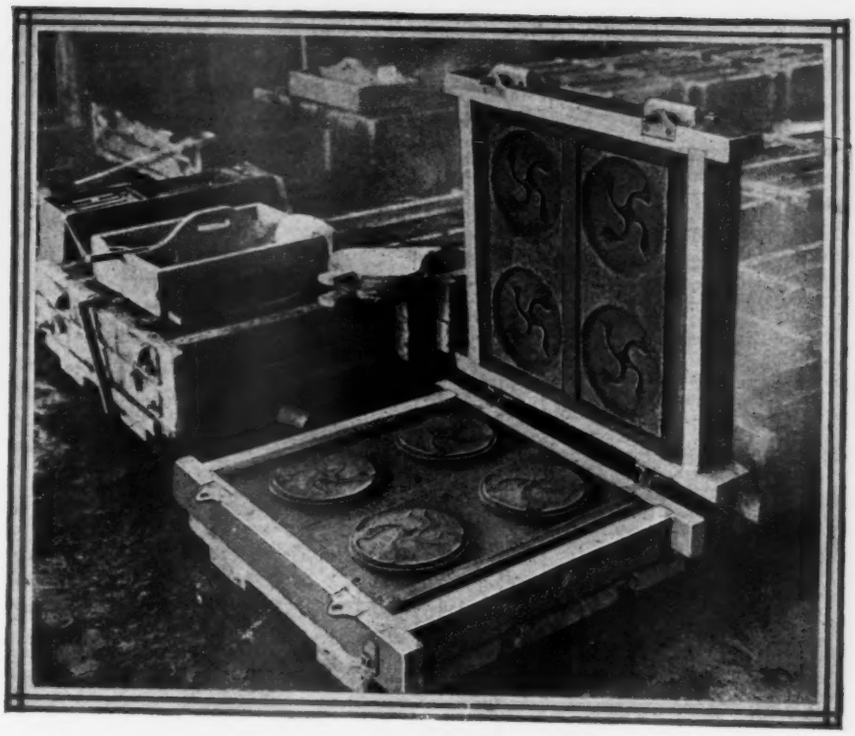


FIG. 4—ONE OF THE HINGED FLASKS, CONTAINING ANCHOR PLATE MOLD

Molding Practice.

On the surface there is nothing unusual in the molding practice of this shop; it is in the little things

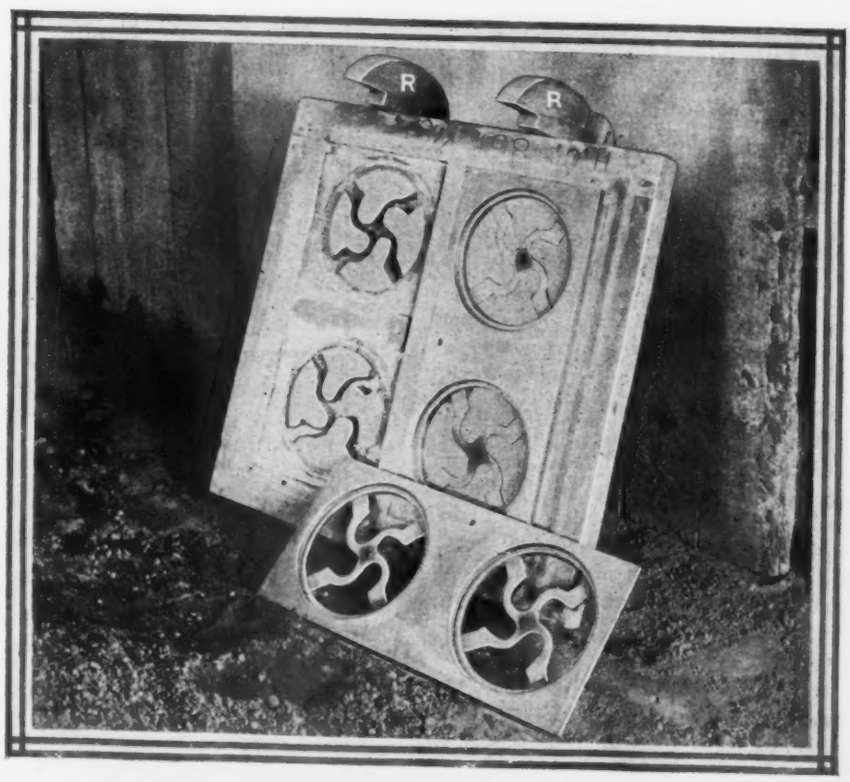


FIG. 5—FOLLOW-BOARD AND METAL PATTERNS FOR ANCHOR PLATE

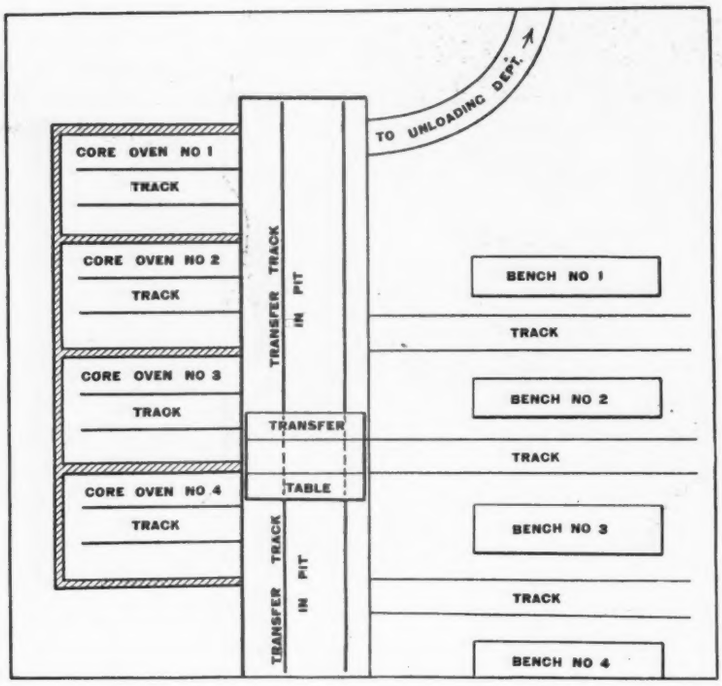


FIG. 6—GENERAL ARRANGEMENT OF THE CORE ROOM

and methods of doing commonplace matters that the interest lies. The shop routine is a model of studied care, neatness and dispatch. No detail of the work has been too small to escape intelligent attention.

The interior view, Fig. 1, shows the general arrangement of the floors, while Fig. 3 shows one floor in detail. The extreme neatness and order characteristic of this shop is very plainly shown in this illustration. Nor does this show a view "tidied up" for the occasion, any casual visitor happening in will find things just as they apepar in this view.

The Floors.

The shop is divided into a series of narrow floors which extend the full width of the molding room, except for the small strip along one side taken up by the narrow gage track. Each floor is a rectangle, about 10 feet wide and 70 feet long.

Two heats are poured daily. In conformity with the best modern practice the molders do no laborer's work, but attend strictly to their work of molding. The second heat is poured late in the afternoon. The flasks are shaken out and the finished castings collected by the night gang employed for that purpose.

The flasks are then set on end in rows parallel to the sand heaps, as shown. Each cope and drag is fitted together so the molder does not have to waste his time hunting for parts of a flask or wrestling with parts that do not fit. The bottom board for each flask is set up beside it and the necessary clamps are laid on top. As the floors are gone over, flasks in bad order are removed for repairs or replacement. Wooden flasks are used but they are kept in good condition.

The sand is cut over and prepared by sand cutters who are paid on a piecework basis; so much for each floor. The molder returning in the morning finds the floor in readiness and everything in place. This attention to detail results in fast work which compares favorably with machine records.

Flask Equipment.

A view of a flask containing two anchor plates is shown in Fig. 4, and the follow board and pattern for this flask is illustrated in Fig. 5. The anchor plate, it will be readily seen, is the plate on which the stove lids rest. These views illustrate a number of interesting details in the practice of this shop. Metal patterns—bronze—are used exclusively. Each pattern is fully gated; the two radial gates for the anchor plate are shown in the patterns illustrated in Fig. 5. The cope part of the pattern fits into the follow board, which is roughly carved to receive it; one pattern in Fig. 5 is shown in its place in the follow board and the other is set up in the foreground. The rough but substantial construction of the follow board is evident. Attention is called to the rockers attached to the follow board. These are marked *R* in Fig. 5. When the drag has been rammed up it is rolled over on these rockers. One man can do this easily. Without the rockers he would have to ask for assistance from a neighboring molder every time he turned over a drag; the man lending his aid would be neglecting his own work in the meantime.

Hinged Flasks.

All the flasks are hinged as illustrated in Fig. 4. One man can handle

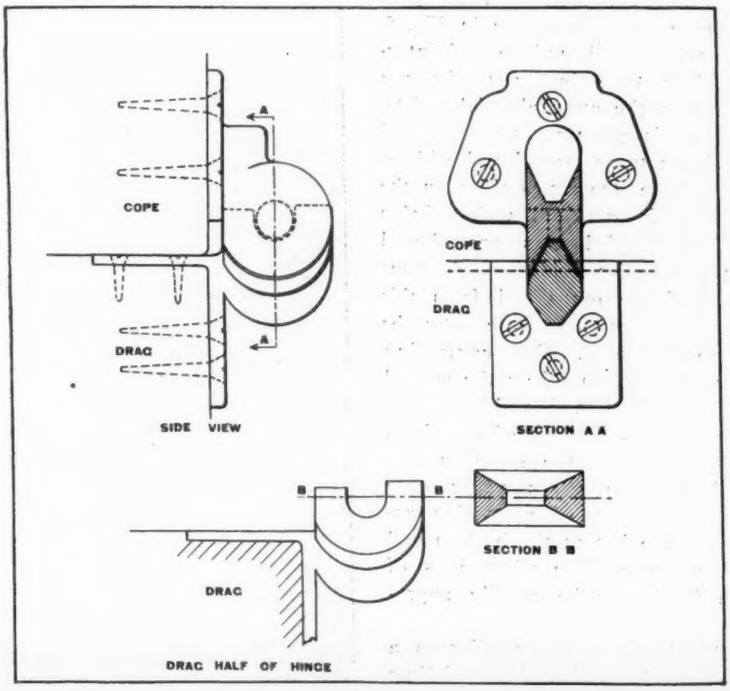


FIG. 7—DETAILS OF FLASK HINGE

the hinged cope easily, but if it had to be lifted bodily, two men would be again required to do the work. The flask hinge does not prevent the cope and drag from being easily separated and all flask parts of the same size are interchangeable. A sketch of this hinge is shown in Fig. 7.

Attention given to the design of inexpensive little things like this flask hinge or follow board rocker, coupled with good organization, has made it possible to effect great economies in the operation of this foundry.

The molders are mostly native-born and a high class of men has been carefully selected. The men are paid on a flat piecework basis. There are no premiums nor bonuses. The piece rates, however, have been very carefully determined and only very rarely changed. A sweeping change in piece rates is unknown in this shop. Wherever possible, the piecework system of payment is employed, not only for the molders, but for all other classes of labor even down to the men who cut over the sand. But one foreman is employed, and there are no sub-foremen or gang bosses. The shop employs 27 molders under ordinary conditions. The men work ten hours daily. In the summer they are not held to any specific hours; they frequently come very early in the morning and then lay off during the heat of the day. By the employment of liberal policies of this sort the tonnage per man per day does not fall off during the hot weather and uniform efficiency is maintained throughout the year.

Molding malleable stove plate of the size and character indicated, this shop, with 27 molders, turns out on an average of 15 tons of good castings per day of ten hours. One molder will put up 50 flasks per day containing 100 anchor plates of the sort illustrated in Fig. 4. Fifty-five flasks containing oven door frames are molded in a day by one man. These records are not phenomenal, yet they could not have been attained without a well-drilled, thinking organization.

Gray Iron Foundry.

In addition to the foundry, already described, which is devoted wholly to stove plate castings, there is a foundry devoted to railroad and miscellaneous castings. The molding floor space is 140 x 760 feet. Five air furnaces, having a daily capacity of 150 to 175 tons, and an open-hearth furnace with a capacity of 50 tons daily, are set in bays entirely outside of the molding floor. This plant is entirely separate from the stove plate shop, so as to avoid all danger of coarse sand working into the fine sand heaps, and to prevent any possibility of mixing the irons, as a special mixture is required for stove plate work. The annealing, cleaning and shipping facilities are fully equal to the capacity of the foundry.

A Word About the Cupola

By P. Dwyer

HAVING perused diligently, for several years, every article in THE FOUNDRY on cupola practice, whether dealing with melting conditions in the abstract, or commenting on the idiosyncracies of some particular cupola—for, like human beings, no two cupolas are exactly alike, or rather I should say, no two cupolas are operated under exactly similar conditions—I am tempted to chronicle in a plain way, for plain people, without any scientific frills or flourishes, some observations and facts gained in a few years' rather intimate relation with one of these burly creatures, which had an inside diameter of 60 inches. A furnace should melt from 12 to 13 pounds an hour for every square inch of bottom area, consequently a 60-inch cupola should deliver between 32,900 and 36,751 pounds an hour.

Low Melt.

When we began experimenting first, this particular cupola was only melting about 10 tons an hour and the iron was not very hot. So long as the heats were small, averaging 25 tons, this condition of affairs caused no great uneasiness, but when they gradually crawled up to about 50 tons, it was realized that something had to be done. At that time, there were eight tuyeres of 6-inch diameter, located 18 inches above the bottom. Wind was supplied by a rotary blower, which could only give 10-ounce pressure. The bed consisted of 2,500 pounds coke; on this was charged 5,000 pounds of iron, then 500 pounds coke and 5,000 pounds iron, and these relative charges were continued right through. After studying the proposition amid much wise and sometimes acrimonious discussion, concerning heat units, blast pressure, carbonic acid gas, the high cost of living and other closely related subjects, it was decided to raise the tuyeres and have them larger, to install a larger motor and fan, to charge more coke in the furnace, and then having done all that human ingenuity could devise to place our trust in providence and let her go.

Changes.

Accordingly, new tuyeres, 8 x 8 inches, were made and placed 24 inches above the bottom. The wind box on the outside was raised to correspond, a large fan was set up and belted to an 85-horsepower induction motor. The motor makes 750 revolutions per minute and carries a 42-inch pulley. The pulley on the fan is 14 inches, giving 2,250 revolutions per minute, and that is going some. A stop gate in the blast pipe regulated the volume of blast, and by shoving it in, or out, a pressure from 1 to 24 ounces could be obtained. We ran the gamut up and down the blast gage and finally settled on 16 ounces as being the ideal pressure. I have often read that blowing too much wind into a cupola retards the melting, on account of all the oxygen not uniting with the carbon of the coke in proper proportion for combustion, but these experiments did not bear out this view. Up to 16 ounces the spur of melting gradually increased, after that it remained stationary. A heavier blast causes greater furnace loss, owing to oxidation, a good deal of iron being carried out through the top of the stack along with a shower of cinders, endangering neighboring buildings. It also wears out the lining much faster, and besides, makes conditions extremely uncomfortable for the men at the charging door.

When the tuyeres were raised, the bed had to be raised to correspond; 3,500 pounds, which left the coke about 2 feet above the tuyeres, was tried first with 500 pounds between the charges. It was not enough, as the iron came cold. We then tried the same bed, but raised the coke charges to 600 pounds and then to 700 pounds, but still results were not satisfactory. The bed was finally increased to 4,000 pounds and the charges left at 700 pounds. This gave iron hot enough but not fast enough. The bed was left at 4,000 pounds and the coke charges gradually reduced to 500 pounds with the iron coming hot enough and at the rate of about 35,000 pounds an hour. After

the furnace had been running a few weeks and the diameter increased, we added a little more coke to maintain the same thickness and then melted a couple of thousand pounds more an hour.

Speedy Melting.

There is no need of pointing out that proper and speedy melting is an economic proposition. The faster a heat can be run off, the more time there is for molding. The hotter iron can be poured, the cleaner are the castings, particularly is this true when the iron has a long way to travel, and naturally the smaller is the size of the scrap pile. A large percentage of dirty castings is due entirely to cold iron, and nothing else, notwithstanding the many theories advanced as to low silicon, high sulphur and the sand, which the scapegoat of a molder left in his mold. A high silicon iron will run cleaner than a low silicon, at a lower temperature, but a low silicon iron will run clean enough if it is melted hot. Take rolls and car wheels. These castings must be clean and solid, and yet the silicon only runs from 0.70 to 1 per cent. Another troublesome feature, when not handled properly, is getting the slag to run freely, thus keeping the furnace melting at its maximum capacity.

Slag Problem.

In furnaces that run long heats, like those used in connection with Bessemer converters, the slag hole is located from 6 to 8 inches below the level of the tuyeres, and there is never any trouble. The objection to this in furnaces that only run two or three hours a day is, that the tuyeres have to be placed so high that the amount of fuel in the bed amounts to quite an item. For that reason, we sometimes see the slag hole nearly as high as the tuyeres. The result is that the slag gets chilled by the blast and will not run out. In a pinch, a slag hole 2 inches below the tuyeres will work with careful handling, but to be safe and foolproof, it should be from 3 to 4 inches below, when it will take care of itself. Some furnace men leave the slag hole open right through the heat, and others open it after the furnace has been running an hour and a half, but it is only a toss-up either way, and really makes no difference. The quantity and quality of the limestone, or other flux, is often blamed, for a furnace not slagging properly, when the real trouble is, that the slag hole is too near the line of the tuyeres. Limestone need not be charged before the sixth or seventh charge and then about 40 pounds for every ton of iron is sufficient. Limestone is a good thing in a furnace, but it does not follow that because a small quantity is good, that a larger quantity is better. The slag created and liquefied by limestone attacks and destroys the brickwork and consequently the more slag carried, the more rapidly is this destruction carried on. Furthermore, it takes a little extra coke to melt a little extra limestone, and when the result runs out the little slag hole, carrying a little of the brick lining with it, the profits accruing to the foundryman are just a little less, and every little bit added to what you have already lost makes just a little bit more.

Bad Practice.

There are a great many things done around a furnace which are not necessary and are done simply because it has always been the custom. One of these is, the practice of leaving the tap hole open after the wind goes on. For 10 or 15 minutes, there is a shower of sparks, slush and slag, blowing out, the furnaceman, meanwhile, standing by with a rod to prevent this sticky mess from plugging up the hole. After a couple of hundred pounds of iron have been run out, he bots up and then gets some friendly person to throw a bucket of water over him in order to escape the fate of Casabianca. There is no need of this ragged edge performance. Just before commencing to blow, the tap hole can be cleaned out, then packed full of old molding sand. When there is enough iron collected for a tap, it is quite simple to clean out the sand, which by this time has dried and will run out like dust. After the first tap, the stopping can be done in the ordinary way.

Cupola Charging

By W. J. Keep

Question:—Will you kindly advise me how to charge a cupola, 42 inches inside the lining and 16 feet in height from the bottom to the charging door? The tuyeres are 4½ or 5 inches above the bottom. There are six lower tuyeres and another row of six, about 14 inches above the top of the lower tuyeres. The bed consists of 400 pounds of coke, 400 pounds of anthracite coal and 150 pounds of coke, or a total of 950 pounds of fuel. This brings the fuel about 18 inches above the upper tuyeres when the wood is burned out. We then charge 1,000 pounds of pig iron and 1,000 pounds of machinery scrap, both broken small. Next we charge 150 pounds of coke and 50 pounds of anthracite, followed with 1,200 pounds of pig and 800 pounds of scrap, gates, etc. The heat is 11 tons, which requires two hours and 10 minutes to melt. The blast pressure is 8 ounces and is increased to 12 ounces. The combined area of the lower tuyeres is three times the area of the blast pipe. My trouble is slow melting and the iron is not hot enough to suit our class of work. The cupola seems to bridge over after the first few charges. Iron and slag run into the tuyeres. I would like to use all coke, and desire to melt 10 tons per hour in this cupola.

Answer:—No mention is made of the kind of work, but it is presumably machinery. I should say that the whole difficulty was in the location of the tuyeres. Even for a cupola using coke and in a shop where the iron is taken away as fast as melted, the bottom of the lower tuyeres should be 12 inches above the sand bottom, to prevent slag and iron from running into the tuyeres. The fire should be lighted two hours before iron is required, to insure a hot cupola. When the charging begins, coke should be 15 to 18 inches above the top of the top tuyeres. I do not see any advantage in an upper row of tuyeres. If only one row is used, less coke is required for the bed. When the last charge comes down, the upper tuyeres are liable to blow air into the iron charge above the coke and chill the iron. The upper row of tuyeres is liable to melt iron in the charge above that which is being melted by the air from the lower tuyeres, and such iron, dropping so far, is liable to be chilled before it reaches the hearth. The slag will also chill before it can get past the lower tuyeres and bung up the cupola. From 6 to 7 tons per hour is the capacity of a 42-inch cupola and it should not be made to melt 10 tons. There is no advantage in mixing anthracite coal with coke, as coke will melt faster than coal. In a machine foundry, the height of the tuyeres above the sand bottom is determined by the quality of the work. They should never be nearer than 12 inches and if a large quantity of melted iron is needed at one time, the tuyeres should be high enough for the hearth to hold it, and frequently they are 3 feet from the sand bottom. A better way, however, is to put the tuyeres from 18 inches to 24 inches high and catch the iron in a hot receiving ladle for a large casting. A 42-inch cupola, melting 11 tons of iron, should be slagged after the sixth charge. The slag hole should be 4 inches below the lower tuyeres. It is impossible to slag if the lower tuyeres are nearer the sand bottom than 12 inches. Suppose you stop the upper tuyeres and raise the lower ones as high as you think best.

ELEMENTS of PATTERN CONSTRUCTION-IV

The importance of pattern joints regarded chiefly from the point of view of the molder

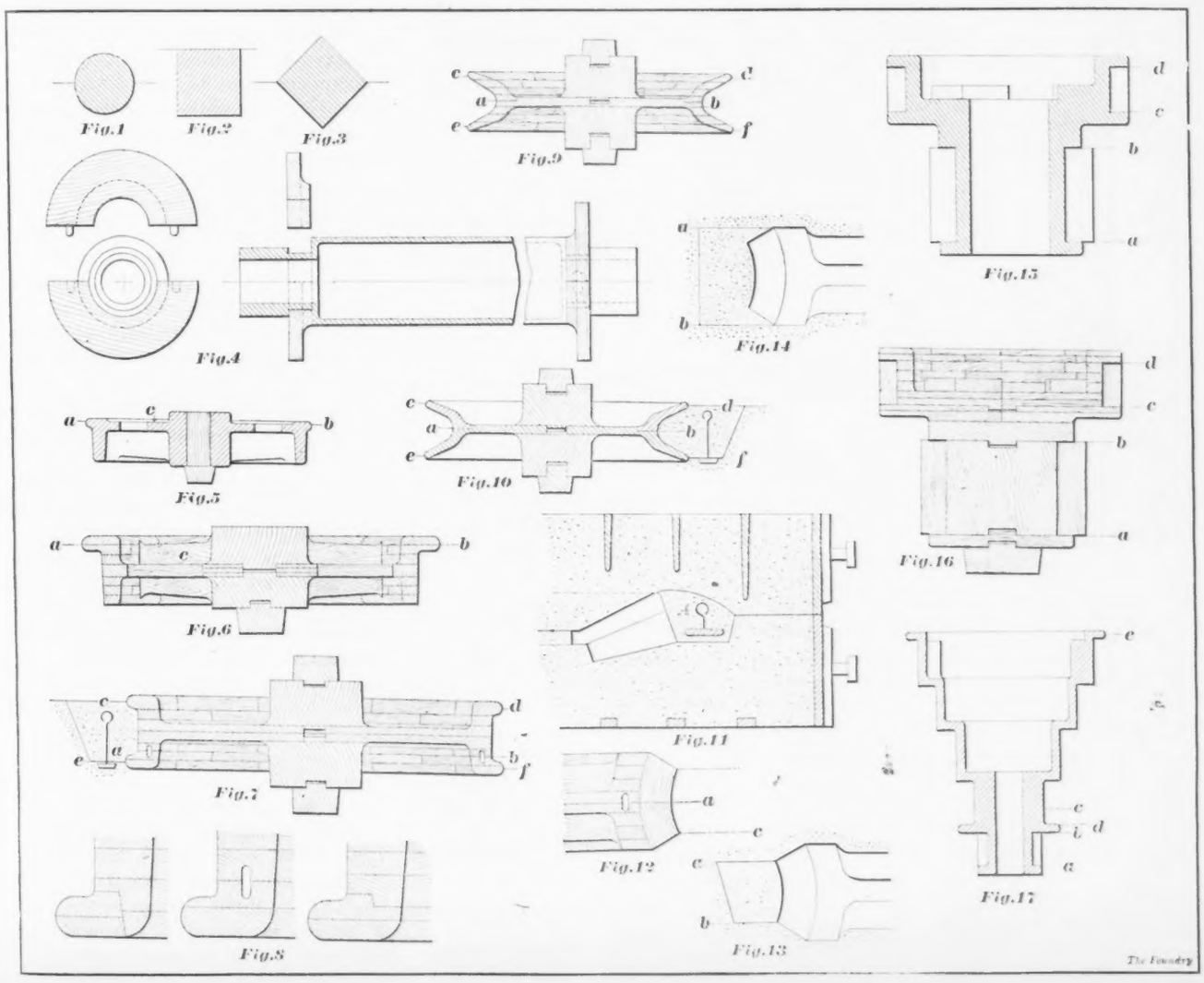
By Joseph Horner

UNLESS the patternmaker regards his work from the molder's viewpoint, as well as from the constructional aspect of the pattern itself, he will often cause trouble in the foundry. Two matters in particular bulk largly here, the methods of jointing, and the determination of the top or bottom faces in molding. There are few patterns in which alternatives to both of these do not exist.

In jointing alone, a number of questions are involved. Though, generally, 'the molder's joint coincides with that of the pattern, or with a face of a solid pattern, this is a rule which has very numerous exceptions. Usually, the joint is located to afford the most easy delivery with the least risk of damage to the mold by withdrawal. But this is not always practicable, and loose pieces, cores, or drawbacks are common devices which are adopted with the object of avoiding excessive quantities of taper, as well as when a lift is impossible, which is often the case.

The determination of the top and bottom faces of a mold may or may not be important. If it is, it is usually because one face has to be tooled, and to insure clean, sound metal, this is better when cast downward. Frequently, however, this would entail undesirable complications in molding. Again, both top and bottom faces often have to be tooled. In these cases especial care is taken to have clean metal, and it is necessary to provide head metal or sullage heads, risers or flow-off gates, and to pour through a skimming chamber. Or, in some cases, the method of molding may be altered, as casting upright instead of flat, when the shape is of such a character as to permit of this alternative. The determination of the top and bottom faces is more frequently settled to give the deeper draw in the bottom and the shallower lift in the top, thus avoiding loose pieces as far as possible. The question of molding in one plane or in another at right angles therewith, frequently arises. So does the question of jointing patterns in different planes, or making them solid and down-jointing the sand partings.

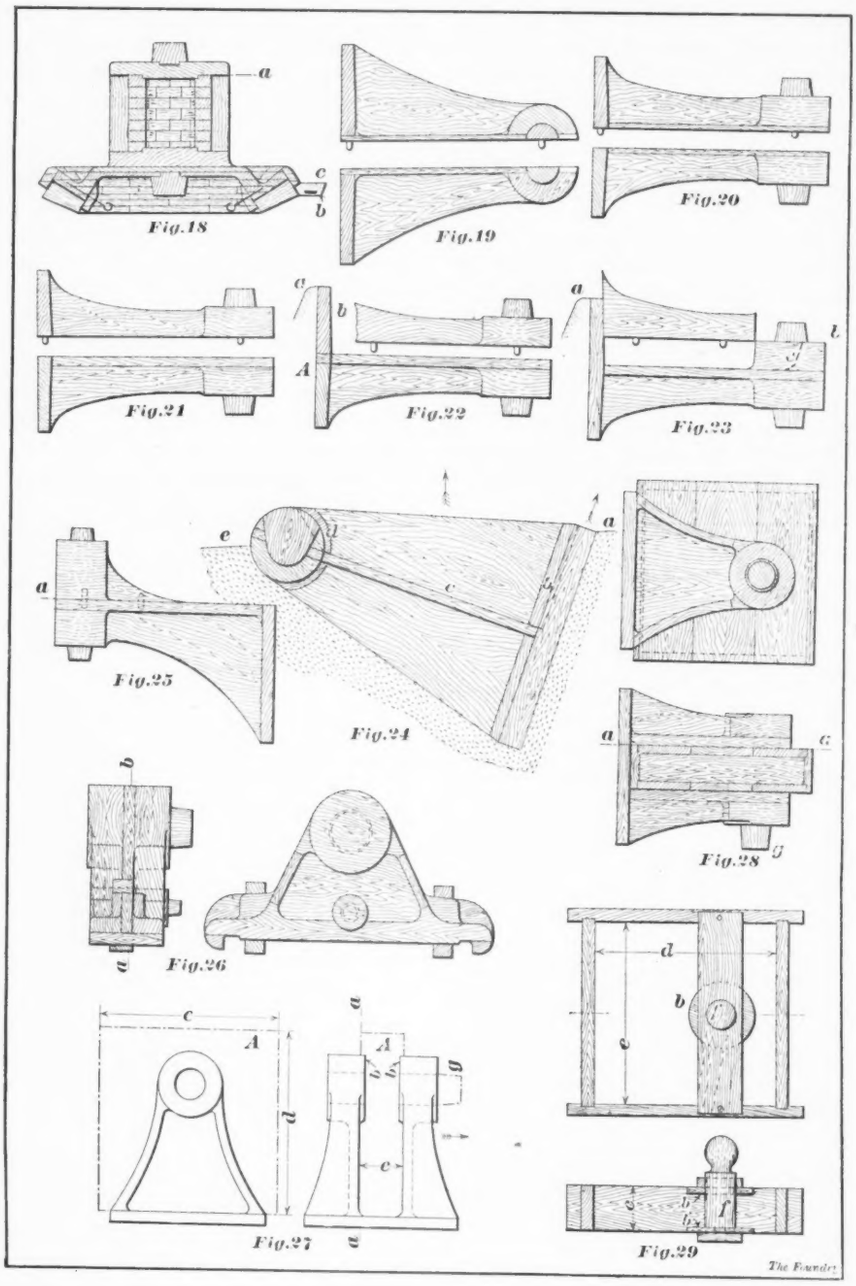
When considering the jointing of



patterns, the pattern-maker, while giving due regard to the convenience of the molder, must also have an eye to the strength of the patterns themselves. In some cases this entails the use of battens which the molder must stop-up. In others, it means making a flat-plated portion, a web or a rib in one thickness, instead of dividing it through the middle plane. Sometimes it involves making patterns solid rather than jointing them through central or other planes, and entails coring them out.

Though, as a broad rule, it is true, as already stated, that the molder's joints coincide with those of the patternmaker, that is far from being of general application. From this aspect the subject may be considered as relating to those patterns which are jointed through the center, and to those which have no such main joint. In the first type the molder's joint usually coincides with that of the pattern, in the second it may be plain, or very irregular.

As taper and lifts are among the principal, dominant conditions, the methods of molding are largely regulated by these. They often determine the method of molding a pattern, whether with edges perpendicular, at angles, sideways, or on end. A few trifling attachments to a pattern will often radically modify the method of molding and coring. Plain lifts come chiefly under three divisions, cylindrical, vertical, or diagonal, Figs. 1, 2 and 3. Patterns jointed along the middle plane, Figs. 1 and 3, are so made for two principal reasons; one being to facilitate delivery in the top as well as in the bottom box; the other is a secondary one, being to serve as a guide to the molder in making his sand joint coincident with the plane of the joint of the pattern and of the molding box. Incidentally, the joint face is often very convenient for the patternmaker to mark out centers on, fitting pieces, and to facilitate measuring distances and centers of fittings.



Solid Patterns.

From the molder's point of view a solid, unjointed pattern is, for some good reasons, preferable to one which is jointed. There are no edges to overlap by reason of shifting of dowels and wearing of dowel holes. In the case of wood patterns, there is far less risk of a solid pattern warping than one that is jointed. And the value of the pattern joint as a guide for making the sand joint can be met equally well by fitting a solid pattern into a recessed joint board as far as the exact central plane, as is commonly done by the brass molders. But if divided patterns are plated and mounted correctly, that is the best practice.

Jointing Patterns.

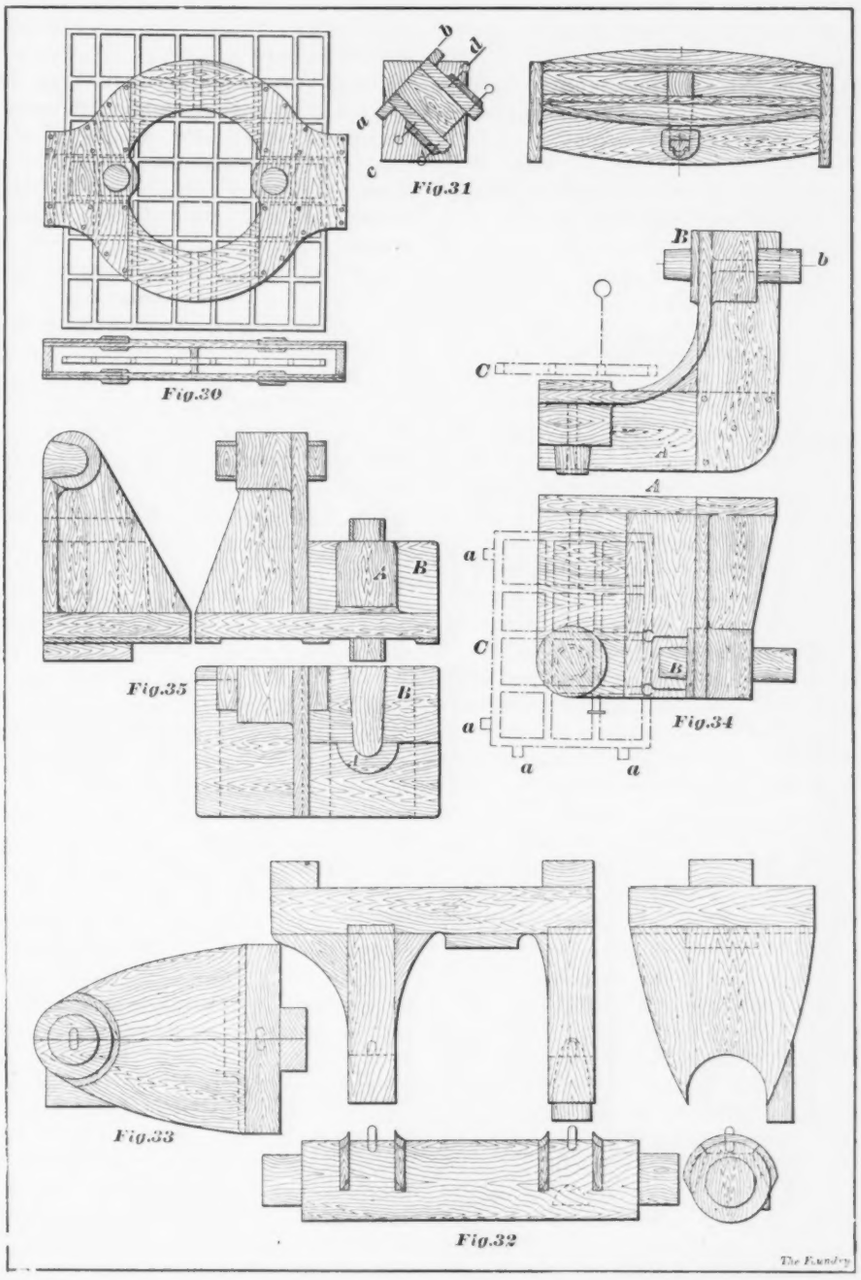
The principal object of jointing being to afford as good a lift in the top as in the bottom, the top part of the mold is lifted along with its half pattern, and this is withdrawn exactly as is the bottom half. Foundrymen know how the risk of broken molds is lessened when the pattern is withdrawn from the sand, than when the top is lifted off the pattern, and the patternmaker must always endeavor to avoid the latter method. This choice arises in scores of cases, not only in the jointed patterns, but in the unjointed. It is the sole reason for leaving many parts loose, as when deep bosses, flanges, or ribs stand up high in the top. In cylindrical work, Fig. 1, the cylindrical portion would eaily deliver if the top were lifted off. But there are usually flanges, sometimes other fittings, shallow o deep with perpendicular faces. Though these deliver freely when the half pattern is withdrawn from the top, they would break down the sand if the top were lifted away from them by hand, or crane. Such pieces, when a pattern is unjointed, are generally left loose, as in the wood half flanges of the iron pattern for a pipe, Fig. 4.

Patterns which are not jointed usually have a mold joint along the plane of the top, Fig. 2. This may be either the joint of a plain top or one with an irregular face. In either kind, portions of the pattern may stand up into the top, and these, unless shallow, are properly left loose to come away in the top. Thus, a solid metal pattern, Fig. 5, has the mold joint along the plane, *a b*, and down to *c* only, and the top, therefore, lifts off easily. In a pattern such as Fig. 6, the joint must extend from *a b* down to the face, *c*, giving a deep lift, and in this case the top arms and boss should be left loose to come up with the top sand. The irregular joints follow the contour of the top of the pattern in work of which this is typical, sloping downward or upward, according to their shape, and these often give deep, awkward lifts. Therefore, as much taper or large radii should then be imparted as is consistent with the accuracy desired.

Superimposed Joints.

There is another class of joints in patterns and molds, those which are superimposed, entailing the use of a three-part flask. Sometimes the pattern joints coincide with those of the mold, but often they do not. There are many familiar examples, the commonest being double-flanged wheels, and sheave pulleys for ropes and chains. The double-flange wheel, Fig. 7, always has the flange loose, which molds in the bottom, the joint being made in two or three ways, Fig. 8. The pattern joint is at *a b*, Fig. 7; the molder having two joints, one along the center of each flange, *c d* and *e f*, and the cheek carries the ring of sand included between these joints. But the cheek may be discarded by carrying the ring of sand on an iron core ring provided with lifting eyes. This ring is rammed and fits within a sloping joint, as shown at the left. Fig. 7, which is included wholly in the bottom box, thus avoiding the use of a cheek flask. In such wheels the boss, which comes in the top, is usually left loose for reasons already noted, coming up in the top and being withdrawn separately from the sand. This is also a case where ample taper must be imparted to the interior of the rim, especially in the top. There is no objection to this, since it is no working part, and the strength and thickness are increased toward the center where the greatest pressure and largest amount of wear occurs.

Sheave pulley patterns are jointed along the center, *a b*, Figs. 9 and 10, which represent wood and metal patterns, respectively. The mold is jointed along the planes of the centers *c d* and *e f*, of the flanges, leaving a cheek between. This is carried in a cheek flask in the larger sheaves. For small sheaves the cheek is discarded and a sloping joint is made within which a loose ring of sand is carried on a circular grid, Fig. 10.



A cheek is seldom used in molding a bevel wheel, although in very flat bevels the outer ends of the teeth depart so slightly from the vertical that down-jointing is liable to cause fracture of the sand. Jointing down is done in ordinary bevel gears, but in the flatter gears a ring of sand, Fig. 11, *A*, is frequently carried on an iron ring, the outer portion of the sand ring being registered against a sloping joint made in the sand of the bottom flask.

Worm Wheel.

A worm wheel gear pattern is jointed along the middle plane at Fig. 12, but the molder's joints correspond with the largest diameters of the teeth, *b*, *c*. The half-patterns are withdrawn from each side of the middle, the molder twisting the pattern and feeling the lift by the coercion of the twist of the teeth. The space from *b* to *c* is occupied by the middle ring of sand. Sometimes the teeth are formed in cores, or by molding machine, Fig. 13, in which case a top and bottom

flask alone are required, and the joint is made as in Fig. 13, *a b*, or sometimes as in Fig. 14. In Fig. 13, sweeps are cut to the shapes shown. In Fig. 14, the bottom and top are both plain.

In the pair of spur gears cast together, Figs. 15 and 16, there are four pattern joints, and four molder's joints, *a, b, c, d*. The bottom mold finishes at *a*, the top at *d*, the intervening space being carried in three middle rings of sand. The actual teeth each occupy separate rings terminating flush with their faces. It is not necessary to have three separate middle-part flasks corresponding in depth with these rings of sand. One or two will suffice, and then either one or two rings will be fitted by sloping joints to register their fitting truly concentric. Such a gear must be made in dried sand if risk against fracture of sand is to be insured.

Cone Pulley.

A cone pulley, Fig. 17, cast with its pinion, is molded vertically. It is usually made in metal for standard work to deliver the interior, except the spindle hole, which is cored. If made in wood to deliver the interior it must be built in segments, which is not a very permanent job, since the joints would start and overlap in time. It would, however, last some scores of moldings. A cheap pattern can be made with the cone steps as solid disc of wood, and the interior can be cored out. However made, the pattern joints are at *a, b, c*. The molder's joints are at *a, d, e*. The pinion is usually and preferably case downward but it may be also cast upward. Such a job would never be molded horizontal with its axis.

The use of a core or cores to avoid the employment of a cheek is common. An example is a crane gear, Fig. 18, comprising a spur and one of the bevel gears for slewing, cast together, both being shrouded. Only one of the pattern joints corresponds with the molder's joints,—that at *a*. One cheek is used, the middle ring of sand extending to *b*. The ring of sand between *b* and *c* is carried on an iron ring fitting within the main middle body of sand by a sloping joint.

Jointing a Bracket.

An excellent object lesson in jointing is a common bracket, Fig. 19, which may occur in all sizes and relative proportions. Such a bracket standing alone, that is not forming some part of another casting, is nearly always molded in one of two ways, sideways, Fig. 19, or flat, Fig. 20. In each case, whichever portion goes in the bottom causes no trouble, and only that which comes in the top requires consideration. Generally, the aim is to have the pattern disposed for molding with the shallower section up and down, and the broader side flat, in order, of course, to lessen the depth of lift.

Different Methods of Jointing.

Different ways of jointing the pattern then are:

(1) Through the center, Figs. 19 and 20, which involves thin and weak webs, and entails the making of the molder's joint in the same plane. This is suitable for the molder because the top half of the pattern comes wholly in the top flask, and is withdrawn from it similarly to the bottom half.

(2) The web may be left its full thickness and all the portions above its face may be left loosely dowelled, Fig. 21. This is as good a way as the last for molding and it leaves the web stronger because it retains its full thickness.

(3) The foot may be made its full depth in one piece, and the boss and rib only dowelled loosely, Fig. 22. The pattern is strong, and the working face *A* of the casting will be flatter than when a middle joint is made. But the molder has to make a deep down-joint at *a*, between top and bottom, and more taper should be imparted on the inner face, *b*, from which the sand in the top has to be lifted away.

(4) The foot is made of its entire depth, and the top part of the boss is fastened on, and the top rib only is dowelled loosely, Fig. 23. Here a sloping sand joint has to be made around the top boss *c*, up to the joint at *b*, as well as the sloping joint, *a*, at the foot. This, though frequent, has no advantages over the previous methods. The methods shown in Figs. 22 and 23, avoid the fins which are liable to occur when patterns are jointed as in Figs. 19, 20 and 21.

Finally, a solid pattern can be used, which will deliver easily by disposing it in molding to give ample taper, as in Fig. 24. The rib in the top should be left loose to come off vertically, and the main pattern should be lifted diagonally in the direction of the arrow to the right. As the rib, if dowelled, would not easily be lifted it is retained in position by being slightly recessed into the foot and the boss, and flanked with fillets or hollows. To avoid a down-joint on the boss faces, a drop print is used. The joint of the top mold, therefore, follows the outline *a, b, c, d, e*.

Fig. 25 is a pattern which might be molded on the side or flat about equally well. Differences in proportions would determine the more preferable method. If molded on its side the prints would be parallel, and if flat, as shown, the top boss and bracket should be loose, and the molder's joint would preferably correspond with the joint, *a*.

In Figs. 22 and 23 the molder imparts as much slope to the sand joint as is practicable, from the top faces of the pattern to the joint face of the box, to facilitate the lift. The latter with few exceptions, is a plane joint. Only in special, deep work are flasks with irregular joints made to match.

Bearing Bracket.

Fig. 26 is a bearing bracket which may be jointed along the middle *a b*, identical halves going in the top and bottom. That is the better method, but it is not necessary. The pattern may well be made solid, as shown, if the recessed portion in the top is well tapered so that it will lift. But down-joints will have to be made over the bolt lugs at the ends and their brackets, for which taper must also be provided. In lifts of this kind the molder is materially aided if fillets of large radii are put into the interior angles, and if the edges of the ribs are well-rounded.

Fig. 27 is an example of a type of work which occurs very frequently, and in almost every case it is better to core out the narrow interior portion with a plain print and core, shown in dotted outline at *A*. The pattern, Fig. 28, then molds down in the direction of the arrow, and there are no loose pieces. The pattern, however, is jointed along the plane *a a*, continuous with the top face of the print.

Cored Work.

It is necessary to put the boss faces, *b b*, Fig. 27, into the core box, Fig. 29, because the thickness, or depth, of the latter is exactly equal to the distance, *c*, between the webs. In Fig. 29, the dimensions indicated by the letters *c, d, e*, correspond with the dimensions shown by the same letters on Fig. 27. The bosses, *b, b*, are carried and kept in position by means of the cross bars dowelled on; *f* is the plug which cores out a print impression to receive the core for the round hole. Sometimes there is no other provision made for coring a round hole in such a situation, but it is, as a rule, safer to put a round print also on the lower side of the pattern as indicated at *g* in Figs. 27 and 28. This becomes a check on the hole in the main core.

Fig. 30 shows a cross-roller frame

pattern for a crane. It bridges between the side-frames, and carries two rollers which run around a belt turned on the central post to steady the crane in slewing. Though it embodies a large open space between plates, similar to Fig. 27, it is not a case for coring. The pattern is like the casting, and the interior delivers, the sand being carried on a grid fitting into the sand of the bottom flask. No cheek, therefore, is necessary. The grid has to be removed from the casting. This is done after breaking out the middle row of cross-bars. The halves left may be used for other smaller cores. As these grids are cast in open sand from stock patterns, they cost little. The interior is rammed, either in green sand, like the mold, and skin dried, or in dried core sand. Rodding, not indicated, is done to assist in retaining the sand to the grid.

Cross-Girder.

Fig. 1 is a cross-girder pattern for carrying a crane roller. The ends are bolted to the side frames and the cross-pieces are set at the angle of the axis of the roller, which runs on a slewing ring. Loose bearings are fitted in the central holes. The thickening facing pieces on the outside are skewered on. These are the only loose pieces on the pattern, and the bearing holes are cut out through their thickness, so that the cored portions of these holes only have to fill up the actual thickness of the ribs. One central print suffices for these, and the core box fills up the holes and stops up the print impressions. The ribs stand vertically in molding. Awkward sand joints have to be made, sloping down to the corners, so that some portion of the ends, those above the line, *a b*, from the corners *c d* come in the top.

Often there is little to choose between the methods of molding. The lathe head, or poppet, Figs. 32 and 33, is a case in point. A two-part flask is required in either case. In one, Fig. 32, the barrel is loosely dowelled to the uprights; in the other, Fig. 33, the pattern parts are all fast. The object in molding the barrel downward is to get sound metal there. Probably the other method is as good. It is equally adopted, and the molder would prefer it because the mold is shallower, and the joint is plane.

Deep Lifts.

The awkwardness and risk of a deep lift is often lessened by the use of a grid carrying a core of sand which, while not a drawback, fulfils an identical function. It avoids either an awkward or an impossible joint, or an excessive quantity of taper. A common example typical of many is a bracket, Fig. 34, having two boss bearings at right angles, the shafts of which carry a pair of bevel gears. Such a pattern might be molded with the foot, *A*, upward, and the bosses downward. In that case the sand above the centers of the bosses would have to be carried by awkward drawbacks, or by means of cores for which prints must be provided. A simpler method is that shown. It only entails leaving loose the boss and print, *B*, which lie on the vertical face. The main portion of the pattern being rammed up, a grid, *C*, is laid on a sand face prepared above the bottom boss, and sand rammed over it. The location of the grid for setting back is insured by the guidance of stakes as indicated at *a a*, driven into the sand in the bottom part of the mold. The top is jointed down to the center *b* of the outer print of the top boss, which has no great depth. It leaves the print impression open for the insertion of the core which is slid along into the impression on the drawback, a top flask being supposed to be rammed distinct from the drawback, and the latter jointed and bolted up to it.

A drawback is only desirable when the lift is deep. A shallow lift is better jointed down when sufficient taper can be imparted, but if not, coring-over is the better method. Fig. 35 illustrates this. The lower boss is covered with a print down to the center to receive a plain core containing a half boss. This boss is better not cored, but left to be drilled out of the solid. If cored, it should have drop prints as shown similar to those on the other boss, but deeper.

A Small Cupola

By W. J. Keep

Question:—I only cast once a week in my regular cupola, which is 21 inches in diameter, but I would like to cast 300 or 400 pounds of iron for light repairs. Can you give me the dimensions of a cupola, 14 or 15 inches inside diameter, which will melt iron hot enough to run stove plate?

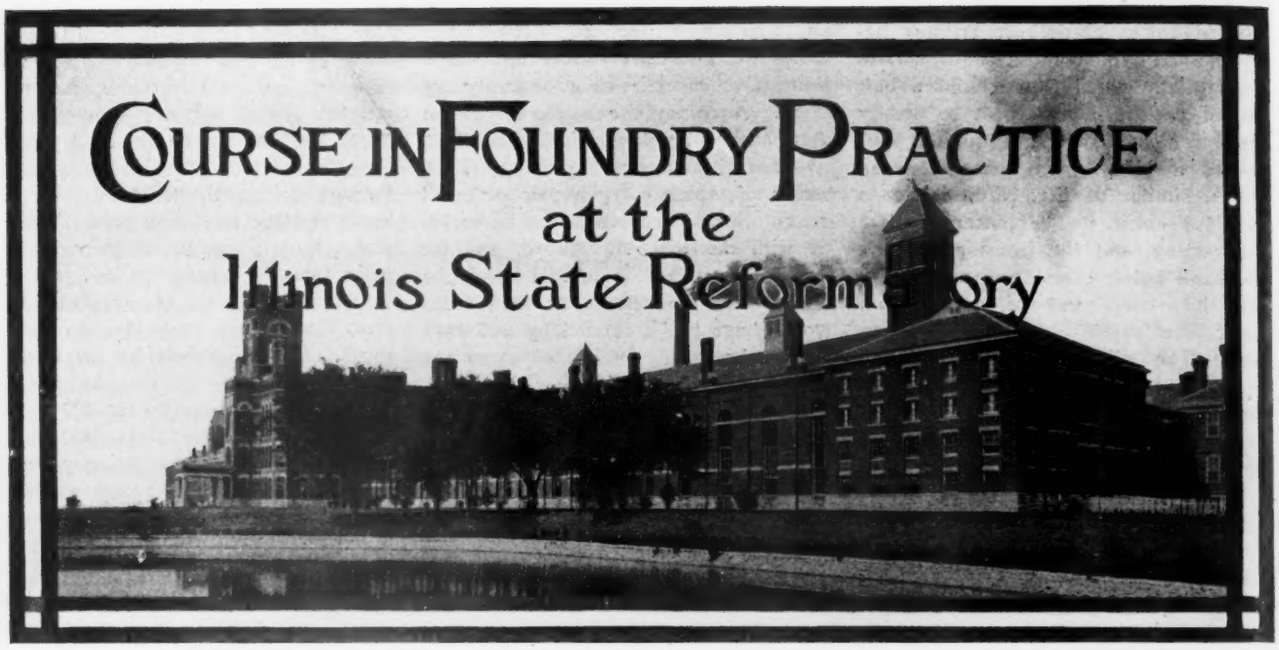
Answer:—You can make a cupola of such diameter by means of a sheet iron cylinder, 4 or more feet long, and about 32 inches in diameter which, when bricked up, will be the required size. The cylinder is set on a steel plate which sustains the sand bottom. The tuyeres should be about 10 inches above this sand bottom. One tuyere, 4 inches in diameter, will answer, but two tuyeres, 3 inches in diameter, one on either side, is recommended. You do not require much blast, but you must provide a fan to give about 6 ounces. When you are through melting, tip the cupola over and knock out the remaining coke, slag and iron. Such a cupola will not give you more than 50 pounds at each tapping. You must break the pig iron into very short lengths and break the scrap very small. Get the cupola hot by burning coke in it for two hours before charging the iron. If you want to tap 100 pounds at one time, or to melt 300 or 400 pounds of iron, I would advise using your 21-inch cupola. If it has an upper row of tuyeres, stop them up. After the wood is burned out, the red hot coke should reach 15 inches above the top of the tuyeres, that is, the lower row. Next charge 200 pounds of iron, pig and scrap, in any proportions you may like. The metal should be broken into small pieces and 20 pounds of coke should be charged.

Crucible Steel

A formula has been patented and assigned to the General Electric Co., Schenectady, N. Y., by Jesse M. Darke, Lynn, Mass., for the manufacture of high-speed steel. It is made by melting and alloying Swedish muck bar, ferro-tungsten, ferro-chromium and manganese by the crucible process. The ferro-tungsten used contains 67 per cent tungsten, the ferro-chromium 68 per cent chromium, and the finished alloy should contain about 13.5 per cent tungsten, less than 0.5 per cent chromium and approximately 3 per cent manganese. The latter metal is added last, and is passed through the slag to prevent its combining therewith, by means of an iron tube which is introduced into the crucible through the slag into the molten metal. The manganese is then dropped through the tube in lumps, the size of a walnut, and is quickly dissolved in the steel. The metal is held for about 5 minutes before being poured.

Associated Foundry Foremen

At a meeting of the foundry foremen of Buffalo and vicinity, held in the rooms of the Manufacturers' Association, 691 Ellicott Square, Buffalo, Wednesday, Oct. 26, preliminary steps were taken to effect an organization of a local of this society. Robert B. Thomson, president of the Associated Foundry Foremen of America, and other speakers addressed the meeting



A Practical Way of Solving One Social Problem

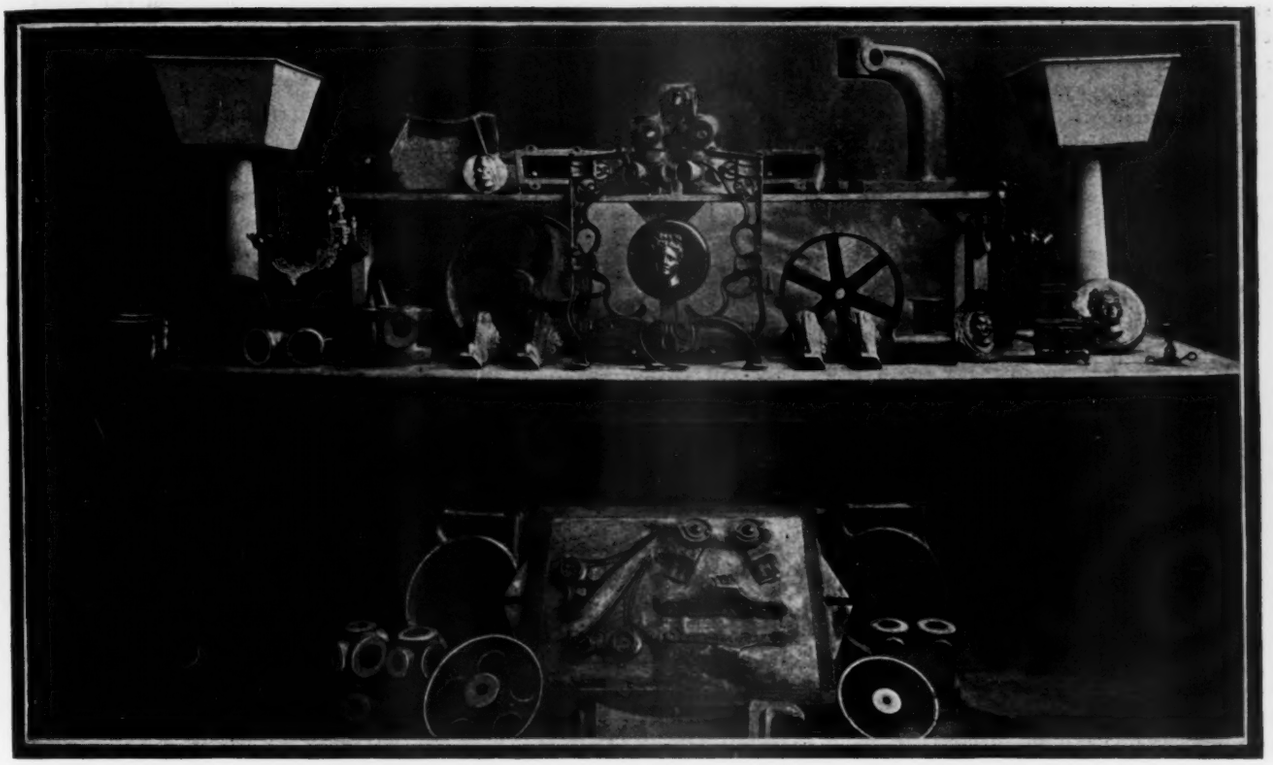
By L. C. Stevenson

ANYONE who has ever paid a visit to the Illinois State Reformatory, Pontiac, Ill., will recall that after having seen all the other departments of this institution, he was escorted to the foundry. The reason this shop is inspected last is to give the visitor an opportunity of seeing the boys pouring their day's work. At this time of the day, 50 boys and young men, ranging in ages from 15 to 25 years, are busily engaged in the various occupations connected with the making of castings in a foundry. I used the term busily engaged, because one would look in vain for that lack of interest and avoidance of minor duties occasionally seen among employes in any outside shop. The boys in this department are working here because they have chosen to learn this particular trade and, as a good many of them are boys who have never had a chance in life, they appreciate this opportunity and are doing their very best to make good.

One would be surprised to see the change that good, steady work brings about in wayward boys who are thus being transformed into honest, industrious citizens. This requires a long and careful study of each boy's disposition and tendencies, a task that can be successfully undertaken only by those who have had a long experience in such work.

When a boy enters the institution

A View of One Section of the Illinois State Reformatory's Foundry Department



A MISCELLANEOUS LOT OF CASTINGS, MADE IN THE REFORMATORY FOUNDRY, WHICH REFLECT GREAT CREDIT UPON THE BOYS

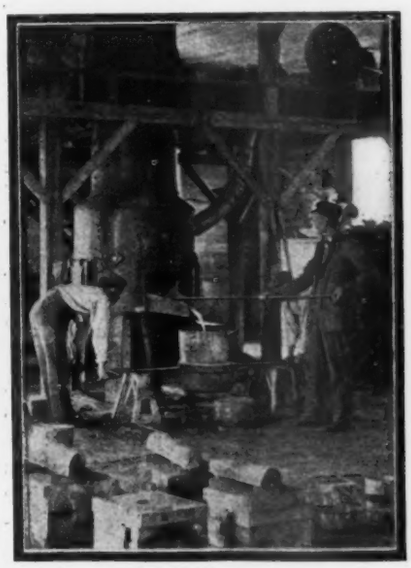
he is asked what trade he prefers to learn. As all the useful trades are taught he has a variety to select from; if he has no preference he is put to work where he can be most useful. If, however, he has chosen a certain occupation he must work at this and do his best, as he will not be transferred except for good reasons.

Foundry Department.

The foundry is located at the west end of the campus, facing the main court. It is 40 x 100 feet, well-lighted and well-ventilated, and is at present employing about 50 boys. The cupola is a Whiting, lined to 30 inches and has a melting capacity of 1½ tons per hour. The average heat consists of 2 tons, although heats of 3 or 4 tons, are not uncommon. The core oven, which is located in one corner of the shop, is 9 feet long, 5 feet wide and 5 feet high. It is fitted up with a core truck with removable decks, it being necessary to use the truck sometimes for conveying dry sand molds into the oven. The oven is fired from the front, and the stack being in the back, the heat is drawn over the cores, insuring a uniform temperature. This oven was designed and built by the inmates. The shop has 10 molding floors aside from the space occupied by the snap molding benches, of which there are four stationary and one portable. There is one brass floor, the metal for which is melted in a natural draft pit furnace. Of other equipment there is all that will be found in any ordinary foundry, such as tumblers, elevator to charging floor, core benches with a liberal supply of stock and special core boxes.

Ccurse of Instruction.

A boy assigned to this department is fitted out with a suit of working clothes and a pair of molders' shoes. Thus equipped he is put to work. If he is a small boy he is put to work helping some inmate doing snap molding and stays there only long enough to learn the principles of molding. He is then put to work by himself. His first castings are necessarily of simple design, and are sometimes cast in lead to show the right and wrong methods of ramming, venting, etc. A boy is never made to put up a whole floor of work for practice. This is the custom in some places where foundry work is taught, but it is not good practice because the output of a foundry consists of castings and he ought to be taught how to make good castings, not only the molds. It makes no difference how good a mold looks, if it does not produce a good casting it does not come up to requirements. It is also somewhat discouraging for a beginner to have his molds shaken out after having taken considerable pains in putting them up. After having spent some time at the bench he is given a floor to work on, making pulleys, sheaves, pipe joints, etc. He is also taught how to make plaster matches and drawing cylinder patterns.



TAPPING THE CUPOLA

He is also instructed in the various ways of gating. The use of skim gates, flow-off gates, drop gates, etc., are demonstrated, and he is given some lessons in drawing cross-sections of molds on the blackboard. So far he has been guided by the in-

structor as to the different methods employed in doing his work. He is now given work that brings his own ingenuity into play. For instance, a broken casting is brought into the shop to be replaced by a new one; it is too expensive to make a new pattern just for one casting, so he is told to take the old one and do what he can with it, and in most cases he turns out a good casting.

Casting Basins.

This incident goes to show, that by following the instructions and being attentive to their work, some of these boys become mechanics of no mean ability. An order was at one time received for one-half dozen cast iron basins, 4 feet 6 inches long, 2 feet wide and 9 inches deep. As no pattern was at hand one had to be made. The entire job, with instructions to make both pattern and castings, was given to a boy 18 years old, who had spent about a year in the shop. It might be mentioned, in this connection, that all the boys are given the privilege of reading the monthly issues of THE FOUNDRY. The boy who was given the basin job had been one of the most ardent readers of this instructive publication, and it was there that he hit on a scheme for doing the job. A wood form was built the exact size of the inside measurement of the basin, and upon this form the pattern was built, care being taken to fit the form snugly all around. After the curved flanges were put on, the pattern was taken off the form, sanded and shellacked. The form was then mounted on a board and during the process of molding did service as a follow-board. Seven good castings were turned out from this pattern, each weighing about 300 pounds. Open sand, loam and sweep molding are taught, but only to the larger boys, as a good many of the boys are too small to handle the equipment with which this work has to be done. The larger boys, who are assigned to this department, assist the cupola tender. After having learned how to mix iron, charge the cupola, etc., they are advanced to the molding floors, doing the heavier work; as a good many large iron flasks are used, quite a few helpers are needed.

The Output.

This department produces nothing for the market, being operated on the manual training and trade school basis. No trouble is encountered in finding a place for the output, as the institution requires a large number of castings at all times. These castings vary in size and shape, and weigh from a few ounces up to 600 or 700 pounds each. A good many engine and machine castings are made for the machine department, thus affording excellent practice at this class of work. Recently an order was filled for 1,000 ribbed, ½ inch plates, each weighing 22 pounds. These plates are being used for making concrete blocks and were turned out at the rate of 50 per day. The main object is, of course, to make the boy interested in the work, and this once accomplished, the boy may be left to himself, for he is easily managed when his mind is kept busy, and this again goes to prove that idleness is the root of, if not all, a good many evils.

A boy sentenced to this institution has, generally, two years to serve, although he may stay here as long as three or four years, according to his behavior. Owing to this fact it is difficult to lay out a course of instruction covering a certain period. Some boys who have served one term came back for violating their parole and these boys may be put on advanced work. It is not very often, however, that the boys who have been employed in any of the trade schools violate their parole, for when they leave this institution they are capable of making a living at the trade they have learned, and this is, after all, the real purpose for which the trade schools at this institution were intended.

The Physical Properties of Cast Iron*

By John Jermain Porter

OF THE elastic properties of metals, only toughness and its opposite, brittleness, and elasticity and its opposite, rigidity, are ordinarily considered in cast iron. Toughness is defined as resistance to breaking after the elastic limit is passed. Elasticity is the amount of yield under any stress up to the elastic limit. It is unusual for these properties to be determined separately in cast iron, but their sum is given by the deflection which is determined in transverse testing. It is probably true that they nearly always vary together and, hence, that deflection is a fairly good measure of either one as well as both.

Toughness of Cast Iron.

Toughness is practically always a desirable quality in cast iron, but the same is not true of elasticity, since in many machines great rigidity is a prime requisite. The factors influencing toughness and elasticity are about the same as those influencing strength, that is, the chemical composition, presence of oxide and size of graphite. All these factors are of importance, so much so that it is hard to give them any order. In general, to get a tough, elastic iron we should keep sulphur, phosphorus and combined carbon low; manganese, no higher than is necessary to take care of the sulphur; graphite and silicon, the less the better, providing that the combined carbon is not increased; and finally, use metal of good quality, melted carefully so as to be free from oxide.

In ordinary gray iron castings it is not practicable to attempt to control the graphite, since the combined carbon needs first attention and the graphite will necessarily be the difference between total carbon and combined carbon. The silicon also must be adjusted with a view to regulating the combined carbon. Practical rules for getting the maximum toughness and elasticity will then be about as follows:

Silicon, 1.5 to 2 per cent for castings of average thickness, more or less for very light and very heavy castings, respectively.

Sulphur as low as practicable, best under 0.080 per cent.

Phosphorus as low as practicable considering the necessity for fluidity. Best under 0.50 per cent.

Manganese from three to five times the sulphur.

Use good irons and good cupola practice to insure freedom from dissolved oxide.

In case steel scrap can be used, the toughness may be considerably increased through decrease in the amount of the graphite and in the size of the grain. The other elements may remain about as before except that it may be necessary to run the manganese a little higher

*Presented at the Detroit meeting of the American Foundrymen's Association.

to counteract the greater tendency of the semi-steel to become oxidized.

Rigidity of Cast Iron.

As previously noted, rigidity is desirable in some cases. This is the converse of elasticity and may be obtained by the direct opposite of the rules given for obtaining elasticity. However, to get rigidity with the least sacrifice of strength and toughness, it is desirable to use manganese and combined carbon rather than to increase phosphorus and sulphur. That is, we would lower silicon as much as necessity for softness will allow, and raise manganese to about 1 per cent (or less in very light work). It should be noted that manganese is particularly efficient in increasing rigidity, since it accomplishes this end with comparatively little sacrifice of strength and toughness. A few examples of very tough and elastic iron are given in the accompanying table.

Tough and Elastic Cast Iron.

No.	Silicon. Per cent.	Sulphur. Per cent.	Phosphorus. Per cent.	Manganese. Per cent.	Combined carbon. Per cent.	Graphitic carbon. Per cent.	Total carbon. Per cent.
1	2.50 to 2.75	0.050	0.30				
2	0.80				0.87	2.34	3.21
3	2.45	0.092	0.63	0.43			
4	1.18	0.084	0.27	0.30			
5	2.36	0.064	0.33	0.24	1.08	2.15	3.23

No. 1 represents iron which, in thin sections, can be punched and bent. No. 2 is an analysis of a gray cast iron which is exceedingly malleable; Nos. 3, 4 and 5 are gray irons showing deflections for the transverse test bars rather higher than usual.

Hardness of Cast Iron.

Under the head of "Hardness" I have included both hardness proper and chilling properties. It will be necessary to consider these separately. It is generally stated that hardness in cast iron is due chiefly to the presence of combined carbon and is only indirectly or to a less extent caused by other elements. The writer believes that this is not altogether true and that there is another factor causing hardness which has not heretofore been generally considered in the case of cast iron. It is well known that when steel is hardened by quenching from a temperature above its critical point its carbon is not in the combined state but rather in a form known as hardening or solution carbon, while the iron is retained in the allotropic form. It is the belief of the writer that the same is true of cast iron and that many cases of hardness are to be explained in this way. For example, Keep describes a sample of cast iron which was too hard to drill and yet contained only 0.60 per cent combined carbon, and many analyses are on record of irons which have been quenched from comparatively low temperatures and are almost glass hard in spite of the fact that the combined carbons are under 1 per cent. I think it probable that the hardness of high manganese irons is due chiefly to this same cause.

Granting for the present the truth of this theory, the presence of the hard form of iron is controlled by the rate of cooling and the percentages of metalloids present; so that for all practical purposes we can say that there are six factors which influence hardness, the rate and manner of cooling, the combined carbon, silicon, sulphur, manganese and phosphorus. The first two of these are of the greatest importance and we will take up in reverse order, leaving the most important till the last.

Factors Influencing Hardness.

Phosphorus has a slight hardening effect in large quantities, but in amounts less than 1 per cent its effects are nearly imperceptible and it does not become important until the amount exceeds commercial limits, or say, 1.5 per cent. We may, therefore, usually neglect the effects of phosphorus in considering hardness.

Manganese, although usually regarded as a hardening agent, may sometimes soften iron. This anomalous result is explained by the action of manganese on sulphur. If the iron is high in sulphur and low in manganese, the first additions of manganese will unite with the sulphur, forming the comparatively inert manganese sulphide and thus softening the iron. If, however, the manganese be increased beyond the amount necessary to care for the sulphur, increased hardness will result.

The hardness produced by manganese is of a rather peculiar character in that it does not always show in the appearance of the iron. For example, a pig iron containing 3 per cent manganese may have a beautiful, open, gray fracture and yet be so hard as to be drilled only with great difficulty. In addition, the presence of manganese sometimes produces a peculiar kind of gritty hardness, the iron acting as if containing small, hard grains. With regard to the amount of manganese required to produce hardness it will be evident that this depends largely on the per cent of sulphur present and also on the rate of cooling. In general, heavy castings will stand up to 1 per cent of manganese without noticeable increase of hardness, medium castings about 0.75 per cent and light castings, 0.50 per cent.

Sulphur is an exceedingly energetic hardening agent, acting, however, chiefly through the carbon. That is, sulphur has a strong tendency to keep the carbon in combined form and in that way to harden. As noted in Part I, page 50, each 0.01 per cent sulphur will increase the combined carbon by about 0.045 per cent, other things being equal. It must be remembered, however, that this applies only to sulphur in the form of iron sulphide, and that in the form of manganese sulphide, that is, in the presence of about three times its weight of manganese, it acts much less energetically. Sulphur also has a direct action in hardening, iron sulphide and manganese sulphide being quite hard substances. Usually this action is imperceptible, but occasionally one meets with hard spots which are due to the segregation of these sulphides.

Silicon is generally known as a softening agent and, within reasonable limits, has this effect due to its action in decreasing the combined carbon. The direct effect of silicon, however, is to harden, since it forms with iron a compound which is harder than the iron itself. When silicon is added to cast iron its first effect, as before stated, is to decrease the combined carbon. This it does, at the rate of about 0.45 per cent for each per cent of silicon added. Actually, the rate of decrease is more rapid than this and, in consequence, by the time we have from 2 to 3 per cent silicon present, depending on the rate of cooling, we have practically all the combined carbon precipitated out as graphite and hence, there is no further possibility of softening in this way. Now, any increase in silicon only increases the amount of the hard iron-silicon alloy, there is no more combined carbon to be decreased, and hence, the hardness will now be increased again. In other words, it is possible to have too much of a good thing, the good thing in this case being silicon.

The actual percentage of silicon which is necessary to secure any given degree of softness will depend upon the size of the casting, the nature of the mold, and the amount of sulphur and manganese present. It is therefore impos-

sible to give definite silicon standards unless each of these factors is known.

Combined carbon, or solution carbon, is the chief hardening agent of cast iron, and, under ordinary conditions,, the hardness of the metal will be closely proportional to the percentage present. Of such relative unimportance are the effects of the other elements that it has been found practicable to use the amount of combined carbon as a measure of the hardness of castings and as a means of predicting their behavior in the machine shop. It is recommended that foundries having their own laboratories pay more attention to this question of combined carbon and regulate the hardness of their castings by it directly. This can be done very accurately in the foundry, since the variations in practice will rarely be great enough to allow of the direct action of the metalloids to have an appreciable effect, and the only other hardening agent is varied in the same direction and by the same factors as the combined carbon.

To machine easily, cast iron should not contain over 0.75 per cent combined carbon. One per cent combined carbon gives a pretty hard casting, and 1.50 per cent is about the upper limit for iron to be machined.

Rate of Cooling.

The rate and manner of the cooling of the casting are usually supposed to influence its hardness only as it affects the percentage of combined carbon. That it does affect the amount of combined carbon is a well established fact. As explained in a preceding paragraph, however, we sometimes get hardness in the absence of any considerable amount of combined carbon. Hence, there must be some other factor at work, which, in the writer's opinion, is a solution of carbon in hard iron, the hard constituent of tool steel.

According to this theory, combined carbon disappears in the temperature range, 2,200 to 1,500 degrees Fahr., while hard iron is not transformed into the soft variety, until the casting has cooled to about 1,300 degrees. Evidently, then, ordinary rapid cooling of castings from the molten state results in both high combined carbon and high *gamma* iron, and hence we have hardness due to both of these causes. The more rapid the cooling, the higher the combined carbon and the higher also the *gamma* iron, therefore, since both vary together, the percentage of combined carbon is a satisfactory measure of the hardness produced by both factors.

If now, the conditions of cooling are changed, this need no longer be the case. For example, suppose we cool the casting slowly from the molten state down to 1,600 degrees and then quench it in water. In this case we would get nearly all combined carbon changed to graphite during the slow cooling through the upper range, while the rapid cooling through 1,300 degrees preserves the *gamma,* or hard iron solution, and hence gives hardness due to this cause.

Some of the peculiar things noted in connection with Custer's process of casting in permanent molds are to be explained on this basis. Also, the much greater softness of castings which have been allowed to cool in sand, and thereby anneal themselves over those shaken out soon after being poured.

Chilled Iron.

Chilled iron is simply white iron, that is, iron in which graphite is absent and the carbon all in the combined or solution state. The same iron may be both gray and white, depending on the rate of cooling, and hence, the exterior of the casting, if rapidly cooled, may be white, while the interior, which cools more slowly, remains gray. Usually there is an intermediate zone having a mottled structure formed through the interlacing and the gradual merging of the gray and white. A chilling iron, then, is one, which, when rapidly cooled, contains all of its carbon in the combined state. The factors which influence the depth and quality of chill are the temperature at which the iron is poured, and the amounts of silicon, sulphur and phosphorus, manganese and total carbon, besides some of the elements which are not normally present in cast iron, but which are occasionally added.

The higher the temperature at which iron is poured the deeper the chill, other things being equal, and it is usually considered advisable to pour chilled castings from hot iron.

Effect of Silicon on Depth of Chill.

The most important element in its effects on chill is silicon, since it is this which has the strongest action in precipitating graphite. For chilling iron silicon should be low, but how low depends on the thickness of the casting, the temperature of pouring and the depth of chill desired as well as on the percentage of other elements in the iron. The accompanying table gives a very approximate relationship between the percentage of silicon and depth of chill, other elements being about normal.

Approximate Relation Between Per Cent Silicon and Depth of Chill.

Silicon, per cent.	Depth of chill inch.
1.50	$\frac{1}{16}$
1.25	$\frac{1}{8}$
1.00	$\frac{3}{16}$
0.75	$\frac{3}{8}$
0.50	$\frac{3}{4}$
0.40	1

Effect of Sulphur in Depth of Chill.

Sulphur tends to increase the combined carbon, and, hence, the chill. So marked is its influence in this respect that it is sometimes added to cast iron to increase the depth of the chill. This, however, is not usually good practice, since the chill imparted by sulphur is lacking in toughness and strength as well as in resistance to heat strains. Scott cites the case of stamp shoes for mining machinery where sulphur was used to increase the chill. The shoes were very hard at first, but soon went to pieces under the repeated blows. Johnson, also, has noted the great difference between high and low sulphur chilled iron as regards ability to withstand the strains of sudden cooling without cracking. On the other hand, West states that the chill produced by sulphur is very persistent to frictional wear, and, hence, it may be inferred that sulphur adds to the life of castings which are subject to abrasion. It has been stated that the presence of a small amount of sulphur is essential in order to get the best results in chilled rolls. This, however, is doubtful and it is believed that it is only rarely that sulphur is desirable in chilled castings. The presence of a moderate amount of manganese in cast iron greatly lessens the bad effects of sulphur in chilled as well as in gray iron castings.

Effect of Phosphorus on Depth of Chill.

Phosphorus in the amounts ordinarily present in the commercial cast iron has but slight influence on the depth of the chill, but does have a more or less injurious effect on its strength. It is generally stated that high phosphorus has the effect of causing a sharp line of demarkation between the gray and chilled portions of the casting. The evidence, however, is conflicting, for Adamson states just the contrary, that phosphorus makes the interlacing of gray and white very pronounced. It is believed that it is best to limit the phosphorus in chilled iron to about 0.4 per cent.

Effect of Manganese on Depth of Chill.

Manganese, since it tends to increase the combined carbon, also tends to increase the chill. However, it must be remembered that the first effect of manganese is to neutralize sulphur, and, therefore, in small amounts it

may indirectly decrease the chill. Manganese very greatly increases the hardness of the chill, and, to a less extent, its strength. It also increases the resistance of the chill to heat strain and hence diminishes the danger of surface cracks in such castings as chill rolls and car wheels. Still another effect is the promotion of a more gradual merging of the gray and chilled portions of the castings. Manganese is usually considered a desirable constituent of chilled iron and the amounts used vary all the way from 0.40 to 3.00 per cent. It is probable that a part of its good effects are due to its deoxidizing action.

Semi-Steel.

Of late years semi-steel mixtures have been used to some extent for chilled castings, the total carbon being considerably lower than in the ordinary mixture. The effect of low total carbon is to give a deep and comparatively soft chill as compared with the shallow, hard chill obtained with high total carbon.

It has been proposed to use nickel as a means of controlling chill, this element having an effect somewhat similar to silicon. Hence, by starting with a strongly chilling iron and adding nickel, the depth of the chill would be lessened in some ratio to the amount of nickel added. Since the same results may be obtained by the use of less expensive silicon it is difficult to see any advantage in adding nickel.

The quality of chilled iron may be very greatly improved by the addition of small amounts of titanium or vanadium. The beneficial effects of these elements are probably due chiefly to their deoxidizing power. Of the other deoxidizing agents, manganese has already been spoken of, and silicon and aluminum are out of the question because of their power of causing the formation of graphite.

Grain Structure.

The fracture of grain size and the porosity are closely related and are both dependent primarily on the size of the graphite particles and, to a less extent, on the percentage of graphite. The factors influencing the amount and size of the graphite were discussed in THE FOUNDRY, October, 1910, hence it only remains to summarize the points to be observed in making mixtures for close, dense iron such as is desired for cylinders and hydraulic work.

Silicon should be kept just as low as possible and still have the castings soft enough to machine. The exact percentage will depend on the thickness of the casting, the character of the mold and whether the casting is allowed to anneal itself or is quickly shaken out after pouring. It may range from 0.75 per cent for very heavy work up to 2.00 per cent for small values, etc. It is believed that the majority of founders use more silicon than is best in work of this character.

Combined carbon has a powerful action in closing the grain and giving a dense iron and should be just as high as possible and still have the iron machinable. Diller found that with radiator loops combined carbon over 0.70 per cent brought a complaint of hardness from the machine shop while if under 0.40 per cent they would usually fail under the hydraulic test.

Manganese had best be kept moderately high, since it appears to have some beneficial effect in closing the grain.

Sulphur is a powerful agent in closing the grain and is frequently made purposely high for this end. It is, however, a dangerous agent, since it may cause trouble in other directions, and as a general proposition it is better to keep the sulphur low and get necessary density by a proper regulation of silicon and manganese.

Finally, one of the best, if not the best, means of closing the grain of cast iron and securing the maximum density is by means of steel scrap in the mixture. This is now common practice with makers of hydraulic castings and is very effective.

Shrinkage.

In considering the shrinkage of cast iron it is necessary to distinguish between the contraction of the fluid mass previous to and during the act of solidifying and the contraction of the solid mass. The first is that form of shrinkage which necessitates feeding in heavy castings, and which so often results in shrink holes or spongy places in heavy sections of castings which are not fed. West calls this contraction of the fluid mass "shrinkage."

The contraction of the solid mass represents more nearly what is generally called shrinkage, this term as ordinarily used meaning the difference in size between the casting and its pattern. This contraction of the solid mass West calls "contraction."

The mechanism of fluid contraction is not well understood but probably Professor Howe's theory of a "virtual expansion" of the outer walls of the freezing casting is very near the truth. I can hardly attempt here to repeat his explanation since the conceptions are very difficult and would necessarily involve a very lengthy discussion. Whatever the explanation may be, however, it is, in general, true that the greater the amount of graphite formed the less is this contraction, hence, the well known fact that the harder grades of iron require the most feeding.

Melting Steel in the Cupola

A process for producing steel castings by melting the metal in a cupola, has recently been patented by Hugh F. Jones, of Los Angeles, Cal. The method consists of charging the cupola with alternate layers of coke, flux and steel scrap, and the ratios mentioned are 7 pounds of steel to 1 pound of coke; 9 pounds of steel to 1 pound of coke, and 10 pounds of steel to 1 pound of coke. The coke, it is stated, should be coarse and the pieces of steel preferably not larger than 25 pounds in weight, the smallest pieces being charged first. Open-hearth steel is used when the castings are to be machined, but if not, the charge can consist of 75 per cent Bessemer steel and 25 per cent open-hearth scrap. The flux, which principally consists of silica and iron oxide, is used in the proportion of 10 pounds to each ton of scrap when the coke contains 2 per cent of sulphur. For each 1 per cent of sulphur over or under 2 per cent, 1 pound of flux is added or deducted. The blast used depends on the percentage of fixed carbon in the coke; thus, for 70 per cent fixed carbon an 8-ounce pressure is used, and for each 5 per cent above or below this, the blast is reduced or increased 1 ounce. Additions of aluminum and ferro-manganese are made in the ladle.

Foundrymen's Meetings

A program of the papers to be presented before the Lancashire (Eng.) branch of the British Foundrymen's Association, has been issued and during the 1910-11 season the following subjects will be discussed: Nov. 6, "The Molder and Chemical Analysis, with Some Notes on Contraction," by F. Andrew; Dec. 3, "Imperfect Castings", by S. G. Smith; Jan. 14, open meeting for the discussion of foundry problems, and annual dinner; Feb. 4, "The Application of the Microscope to Foundry Practice," by G. Hailstone; March 4, "Theory and the Foundryman," by H. Sherburn; April 1, "The Scope of Science to the Foundryman," by T. H. Hawley; May 6, "Some Foundry Problems," by D. Cordingley.

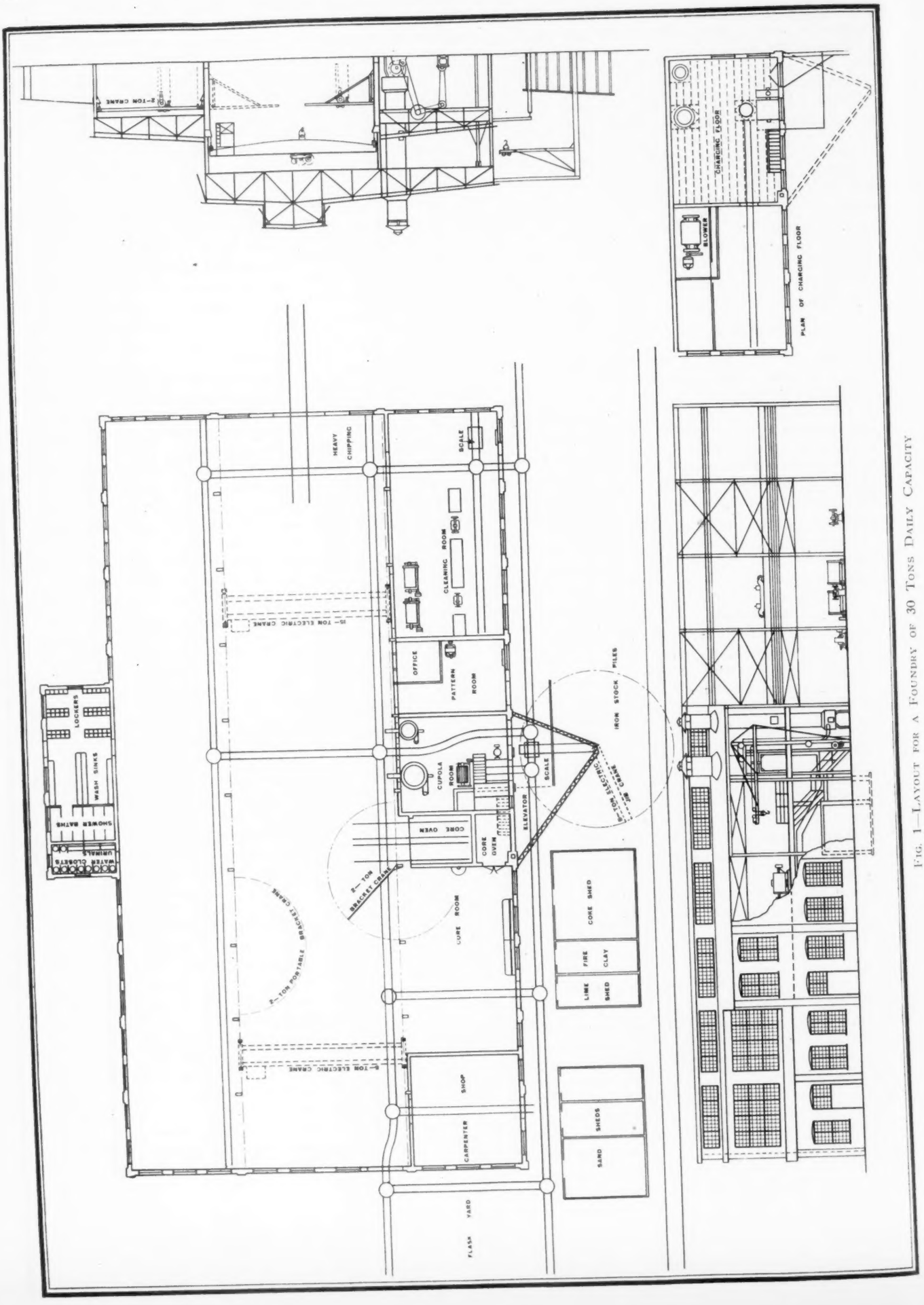


FIG. 1.—LAYOUT FOR A FOUNDRY OF 30 TONS DAILY CAPACITY

TYPICAL MODERN FOUNDRY LAYOUTS—II

General arrangement and equipment of gray iron foundries of varying capacities, from 30 to 120 tons daily

IN THE first article of this series four small gray iron foundries, one of which was equipped with a brass department, were described. The smallest of these was of 5 tons daily capacity and the largest only 20 tons. In this installment the layouts of four more gray iron foundries are presented. The capacity of these shops are respectively 30, 60, 75 and 120 tons per day. Each of these layouts has considerable individual interest, although the underlying principles in the design of gray iron plants are the same, whatever the size of the shop. For the layouts illustrated herewith we are indebted to the Whiting Foundry Equipment Co., Harvey, Ill. None of the plants illustrated in this article are provided with brass departments. The designs are such, however, that it would be an easy matter to fit out a corner in the main bay of any of these shops with brass furnaces and brass molding apparatus, thus adding a small brass department to the equipment of the plant.

Building Construction.

The buildings illustrated herewith have structural steel frames, the center bay columns being reinforced to carry the traveling crane. The cross-section of each building shows a gabled main bay fitted with a monitor roof, with an auxiliary bay covered by a leanto roof on either side. The steel frame is covered by curtain walls of brick or concrete. Abundant window area is provided. The monitor extends the full length of the main bay and provides both light and ventilation. Heating systems insure a proper temperature in winter and serve for ventilation in summer. Each plant is fitted with toilet accessories including lockers, wash bowls and shower baths. Space for these facilities is provided either in the main foundry building or in an adjacent, separate structure.

Handling Raw Material.

There are certain other general features which are similar in all four plants. In the smaller plants the stock yard is traversed by an industrial railway and in the larger ones it is also spanned by a traveling crane which is used to handle pig iron and scrap, either by means of an electric magnet or slings, to load charging cars and to handle coke for storage. The industrial tracks are laid so as to reach all points on the molding floor and to connect with the stock piles, flask yard, etc. The industrial railway is principally used for handling flasks and materials. In some cases, ladle cars are provided for the transportation of hot metal in the shop. The scrap breaker is either bracketed to the building or is of tripod design, operated by a pneumatic air hoist.

Charging Floor.

The charging floor is built of structural steel of sufficient strength to support loaded cars, coke and pig iron. A system of turntables, or a transfer table, is generally located on the charging floor in connection with storage tracks. The elevator is electrically operated or a pneumatic type. This floor is frequently extended and partitioned off, the space being utilized for storage of foundry supplies and tools and also for coke when ground space is limited. The blowers are installed in an enclosed space on the charging or mezzanine floor in convenient proximity to the cupolas. In all of the plants illustrated in this article, two cupolas of different sizes are used. This provides for a range of tonnage output, and permits the melting of different mixtures at the same time. In the larger shops a small test cupola may be installed for experimental purposes and to serve as a general portable or repair cupola for light work. Where the cupolas are adjacent to frame buildings a spark arrester is used to turn downward sparks and cinders that come from the stack.

Cupola Equipment.

With cupolas 48 inches in diameter inside of lining and larger, pneumatic charging machines prove economical. Loaded cars are held in storage on the tracks on the charging floor and are run on to the charging machine in front of the cupolas as needed. In the cupola room, a spur geared cinder mill of the dry type is installed, which receives practically all of the iron in the slag and drop. The reclaimed coke is used in the core ovens. In the 40 to 75-ton layouts the core oven fire pits are adjacent to the cupola room. The cupolas are enclosed and the cupola room is provided with industrial railway tracks so that ladle cars may be run into this room, where they are lined and dried, relieving the foundry proper of smoke. Bottom door hoists are advisable for cupolas more than 45 inches in diameter.

Core Room Equipment.

The core room is provided with standard drying or core ovens of sizes commensurate with the capacity of the plant. Where there is limited head room, a roller curtain type of core oven door is used. From two to four ovens are installed, depending on the size of the plant. The core room may also be equipped with a small, portable oven for drying small cores in a hurry. One or more standard coremaker's benches, 3 x 12 feet, are also provided in this room.

Crane Installation.

Internal transportation, generally, is supplied by traveling cranes supplemented by portable bracket cranes. The average span of the crane is 40 to 60 feet. The columns of the building are provided with the necessary pin bearings so that the bracket cranes can be shifted as desired. In the larger plants spur geared crane ladles are provided. A feature of the 30-ton plant is the electric jib crane which is used to cover the iron stock piles. This crane is anchored to the building columns, the pivot being set 23 feet out from the wall. The crane has a radius of 21 feet, 6 inches, thus covering a ground area of 363 square feet.

Equipment of a 30-Ton Shop.

The necessary equipment for the 30-ton shop is in detail as follows:

One 3-motor electric traveling crane, 45-foot span, 15-ton capacity, in the main bay.

One 3-motor, electric traveling crane, 45-foot span, 5-ton capacity, in the main bay.

One 2-motor electric traveling crane, 30-foot span, 2-ton capacity, in the side bay, opposite the cupolas.

Three 1-ton electric portable bracket cranes.

One cupola, 54-inch diameter inside of lining, 45-foot total height, capacity 12 tons per hour.

One cupola, 32-inch diameter in-

FIG. 1—LAYOUT FOR A FOUNDRY OF 30 TONS DAILY CAPACITY

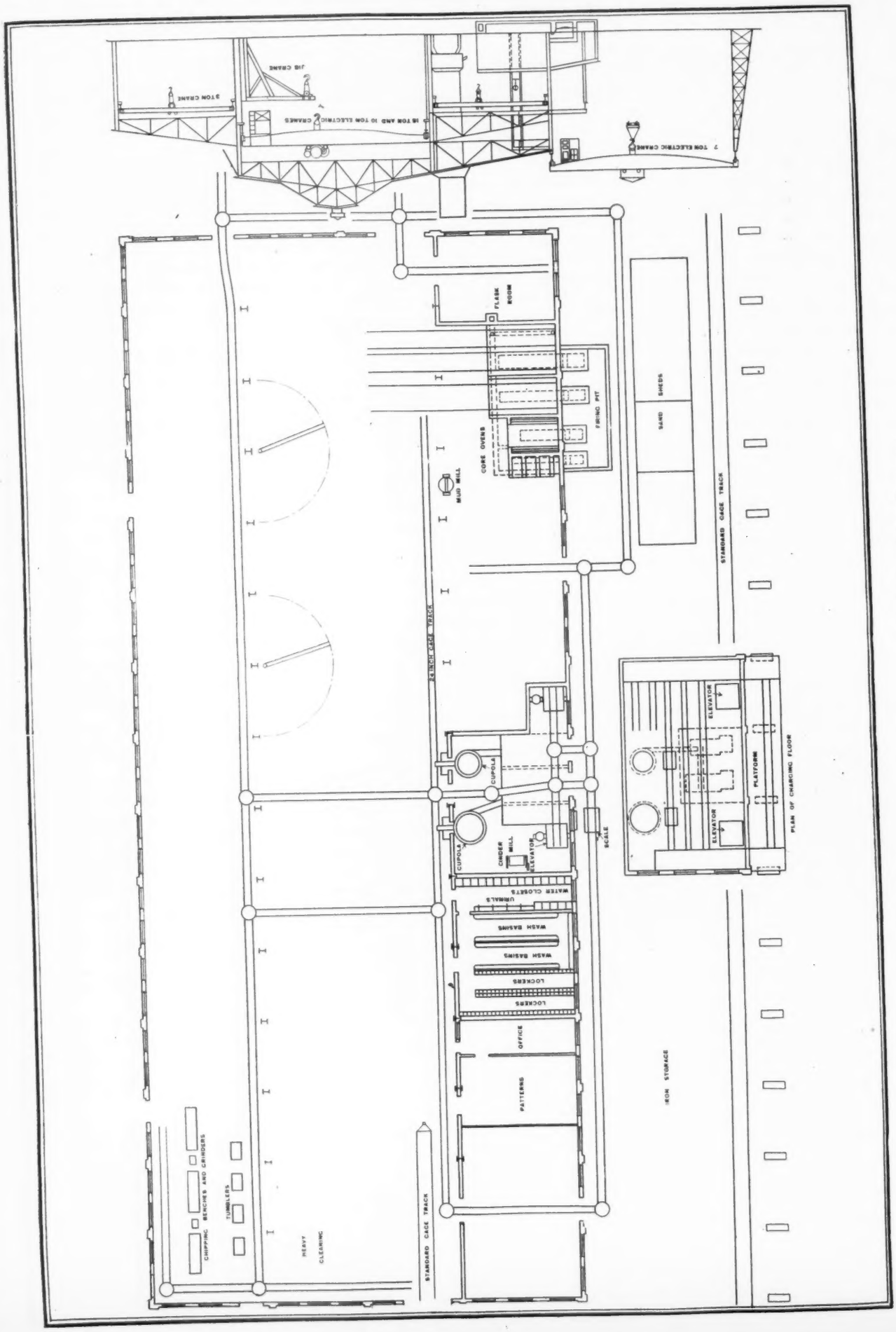


FIG. 2—LAYOUT FOR A FOUNDRY OF 60 TONS DAILY CAPACITY

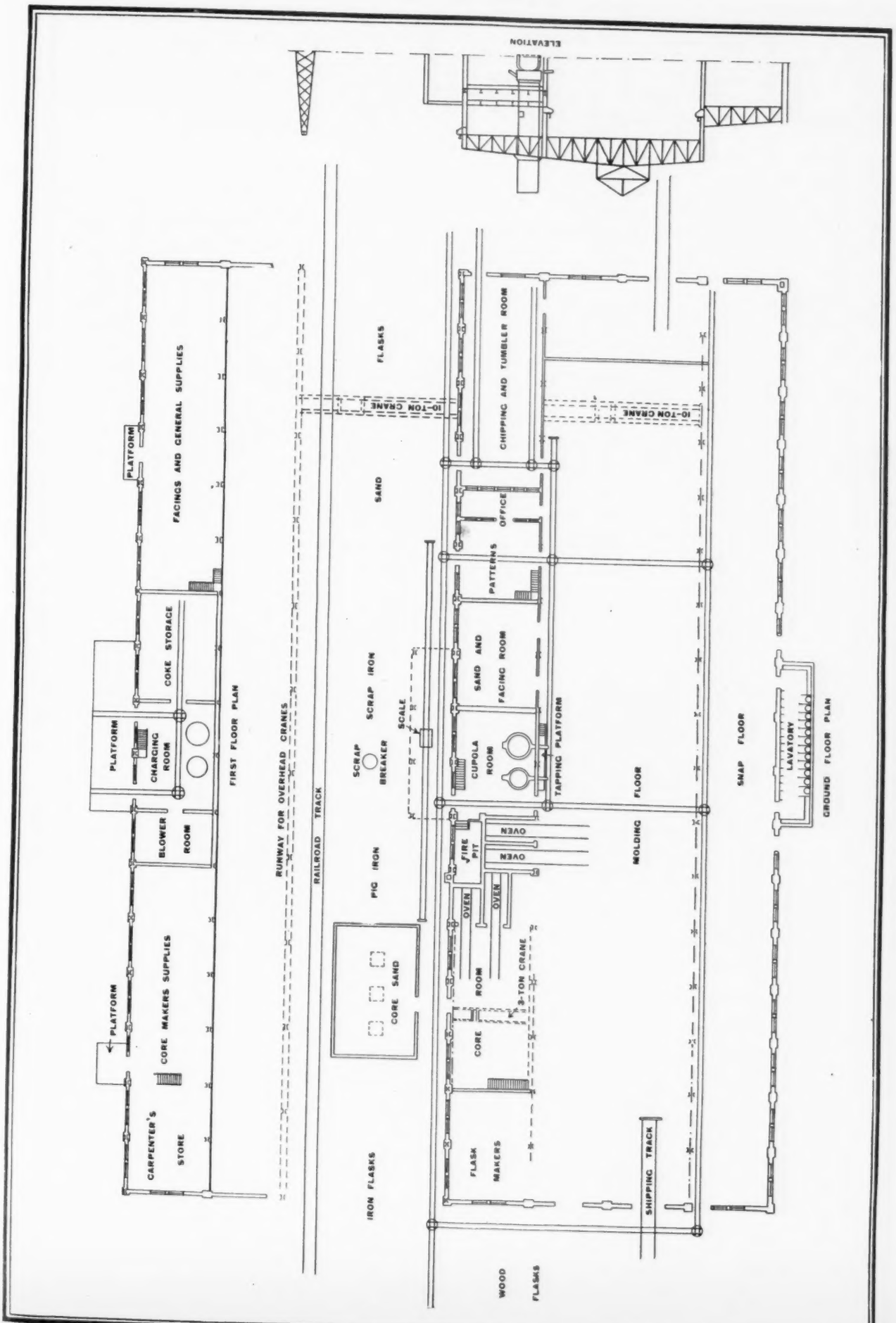


FIG. 3—LAYOUT FOR A FOUNDRY OF 75 TONS DAILY CAPACITY

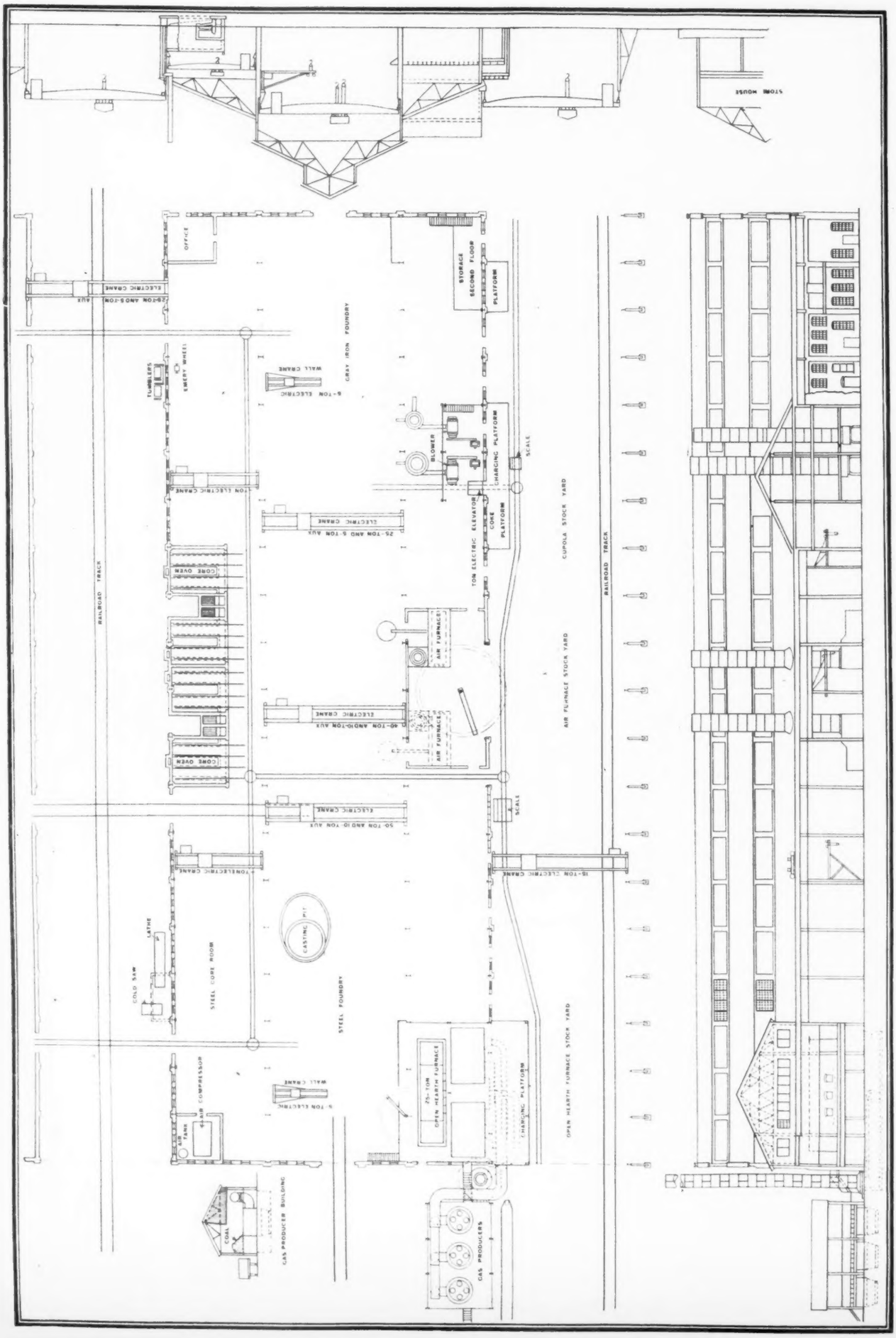


FIG. 4—LAYOUT FOR A FOUNDRY OF 120 TONS DAILY CAPACITY

side of lining, 45-foot total height, capacity 5 tons per hour.

Two positive pressure blowers, one for each cupola.

Two sets of cupola bottom door props with hoists.

One 3-ton pneumatic charging floor elevator, 18-foot lift, 5 x 7-foot cage.

One 3½-ton charging scale with 4 beams.

One 1,500-pound portable platform scale.

One pneumatic scrap breaker.

One core oven, 18 feet long, 14 feet wide, and 9 feet high.

One core oven, 14 feet long, 8 feet wide, and 9 feet high.

One portable core oven.

One 5-ton core oven car, 6 x 12 feet, with racks to go into largest oven.

Two portable pneumatic sand sifters.

One core machine.

Two standard coremaker's benches, 3 x 12 feet each.

Twelve 2-ton yard trucks, 3½ x 5-foot platforms for the 21-inch gage industrial railway.

Fourteen 48-inch turntables.

One 10-ton spur geared crane ladle.

One 5-ton spur geared crane ladle.

One 2-ton spur geared crane ladle.

One 1-ton spur geared crane ladle.

One truck for 1-ton ladle.

One 1,500-pound ladle car.

Ten 250-pound bull ladles.

Ten 50-pound ladles.

One cinder mill, 36 inches in diameter and 48 inches length of barrel.

One spur geared tumbler, 36 inches in diameter and 60 inches length of barrel.

Two motor-driven grinders.

Three chipper's benches.

One 6-ton industrial track scale.

One 1,500-pound portable platform scale.

In this plant the locker rooms, toilet arrangement and shower baths are in a separate building adjacent to the side molding bay.

The 60-Ton Foundry.

The 60-ton foundry is equipped with one cupola, 54 inches in diameter inside of lining, and one 72 inches in diameter inside of lining. The main bay traveling crane in this plant has a span of 53 feet and a capacity of 15 tons. The side bay crane is 3 tons capacity with a 32-foot span. Two 1-ton jib cranes of 20-foot radius are supplied. The fire pit for the three core ovens is situated out of doors, fuel is brought to the pit, either by the industrial railway or the yard crane. This crane, which spans the storage yard, has a capacity of 7½ tons, a span of 53 feet and a height above ground of 37 feet. The layout of the 60-ton plant shows a molding floor, 300 feet long and 85 feet wide.

The 75-Ton Foundry.

The design of the 75-ton foundry is very similar to that of the 60-ton plant. The side bay in the 75-ton plant, however, is narrow and is used for snap flask work. The side bay occupied by the cupolas is fitted with a mezzanine floor which gives extensive space for facings and general supplies, and also for lumber for the flaskmaker's department. The molding floor in this plant is 340 x 89 feet.

The 120-Ton Foundry.

The 120-ton foundry has a number of special features. It is fitted with two cupolas for gray iron, but would have three if it were designed for producing gray iron castings only. The inside diameter of the smaller cupola is 45 inches and the two larger, 72 inches. The capacity of the cupolas is 8 and 18 tons per hour, respectively. The main bay, which is 400 x 60 feet, is spanned by three traveling cranes of 60-foot span. The crane capacities are 50, 40 and 25 tons respectively. The 50 and 40-ton cranes are equipped with 10-ton auxiliary hoists and the 25-ton crane is furnished with a 5-ton auxiliary hoist. The main bay is also equipped with two 5-ton, electric wall cranes. The side bay is furnished with two 5-ton, electric traveling cranes, each having a span of 37 feet. The core ovens, four in number, are located opposite the cupolas. The ovens are 25 feet long, 15 feet wide and 10 feet high. The fire pits are located between the first pair and last pair of ovens. This plant is also equipped with a 18-ton air furnace for producing malleable castings and with a 25-ton open-hearth furnace for making steel castings. The cupolas, air furnaces and steel furnaces are all located in the side bay, the open-hearth furnace being at one end and the cupolas at the other. The open-hearth furnace has a hearth 10 x 24 feet in size. It is equipped with a charging machine and a 12-foot jib crane handles the ladles directly in front of the furnace.

Stock Yard.

The stock yard is divided into three sections. One section is devoted to the steel foundry stock, another to the malleable stock and the third to the gray iron stock. The stock yard is served by a 15-ton crane having a 58-foot span and a clear height of 38 feet. This foundry was designed to be placed adjacent to a machine shop, the distance between the two buildings being 60 feet. The space between the buildings is served by a 25-ton traveling crane.

Modern Coremaking Machines*

By Daniel F. Eagan

HOW often we find foundries completely equipped with molding machines of various types, yet their maximum output is often held up because of the inability of the coremakers to produce the necessary amount of cores to "core up" the molds. It will, invariably, be claimed that it would only be necessary to hire more coremakers to get the desired result, but, experience has taught us that the mere hiring of more men does not necessarily mean a greater output, so that we must look to coremaking machines if we are to keep pace with the increase of production due to the rapidly increasing use of machines for making molds.

The coremaking machines on the market at present consist chiefly of the kind that make straight cores whose section is formed by various shaped dies, such as the round, square, and slab designs, and that they do splendid work is well known. They have their limitations, however, and we are compelled to look further for machines that are capable—in the hands of men not necessarily coremakers—to produce any class of work in quantities sufficiently large to obviate any claim of restriction in output.

Complicated Work.

Complicated cored work, if anything, is on the increase in this country. The automobile industry, in a measure, is responsible for a class of core work that has opened the eyes of the manufacturers in other lines to the possibilities of making castings in one piece that were usually made up of several sections. This very often means that the bulk of the work is thrown on the coremakers, the molding being in many cases a very simple operation; and, as it is necessary, if good work is desired, that each core must be like its mate, there is but one way to produce it, and that is with a machine upon which the corebox is mounted and which is so constructed

*Read at the September meeting of the Philadelphia Foundrymen's Association.

that the sand can be both jar and hand-rammed, while the core can be dropped away from the corebox without any of the excessive rapping.

Stripping Plate Machines.

Let us then consider the types of machines best adapted to the many requirements of coremaking. By making the dividing walls of any core box to strip through the body of the core, it is only necessary to fasten the walls to the stripping plate, leaving the body of the corebox on the table. Of course, this would mean a considerable first cost, but on repetition work it pays to spend money liberally on any rigging that will materially decrease the cost per piece. A case in mind will illustrate this point. A casting that cost 23 cents in labor per core was "rigged up" on a stripping plate machine at a cost of $72, and the cost per core was cut to 8 cents. This, at first thought, appears to be an almost impossible saving, as one is apt to believe that the mere stripping of one part of the box through the other would make but a fraction of a minute's difference on each core as compared with drawing away the corebox by hand. In this instance the saving was made by the use of the stripper. It was not found necessary to nail and wire the core as by the hand method.

On such castings as automobile and motor boat engine cylinders, carburetors, pump cylinders, valve chambers with internal dividing walls of thin section and, where one part of the core must be relatively correct to its adjoining and connecting parts, it will be found that by making the dividing walls of any core-box to strip through the body of the core it is only necessary to fasten the walls to the stripping plate, leaving the body of the corebox on the table, so that it can be turned over and lifted off the core by hand.

Rock-Over Drop Machines.

On halved work other than that of the repetition variety, where the bulk of both box and core is such that it is difficult for one man to handle, the rock-over drop machine can be used to advantage. By fastening the bottom of the box with wood screws to the pattern plate and using this the same as a bench when ramming, and by releasing the hook at the side of the machine, moving the handle up and down, a jarring effect results, thus aiding the initial ramming very materially; after the face of the core is struck-off a core plate is placed in position, a clamp bar brought over and the whole rocked over on flask rests. The clamp bar is then dropped and at the same time the foot lever is operated, the back of the pattern plate is tapped with a wooden mallet, the core leaving the box perfectly, resting on the core plate ready for the oven. This method of making cores requires no special rigging. Perfect cores are made without injury to the corebox, and one does not have to figure on large orders to make it pay. When not used for coremaking, they are very useful in making molds, such as flatbacks when used singly, or almost any class of work when operated in pairs.

Jarring Machines.

On large work that ordinarily requires the services of two or more men, the plain jarring machine effectively reduces the cost of ramming. The sand should be banked above the sides of the core box for several inches. It is only necessary to admit air to the jarring cylinder and the machine will do the rest in a manner that will astonish those not acquainted with this method of making cores. It is not necessary to fasten the box in any way on the platen, as the jarring action affects the sand only. The sand is rammed so well that all that is required is to strike off the face and roll-over, which, in this case, is usually accomplished by using a crane. On large work of this kind, trunnions or slings are fastened to box before beginning operations.

There are several types of jarring machines on the market, some of them embodying the rock-over and jarring principle. What the future holds in store in the line of coremaking machinery is of course problematical, but at the present stage of the development of the molding machine, we are well able to cope with any output that any make of molding machine may give us by using a little judgment in the selection of the machines best adapted to making cores for machine-made molds.

Shrinkage Chart

By W. J. Keep

Question:—Will you please inform me if you publish a chart showing the amount of contraction in iron castings in relation to cross-section and silicon contents?

Answer:—I have published several such charts. In my book, "Cast Iron," pages 47 and 155, will be found tables giving the information required. On page 156 is one of the charts referred to. A better chart will be found in a paper on cast iron in *The Transactions of the American Society of Mechanical Engineers*, 1905, Vol. XXV.

Gray Iron Mixture for Bedstead Work

By W. J. Keep

Question:—Can you give us a good mixture for bedstead work, and other information relative to this practice?

Answer:—The pig iron should be high in silicon and phosphorus, approximately 2.75 per cent silicon and 1 per cent phosphorus. It may be advisable to use even a higher percentage of silicon, as the melting is continuous and the pouring intermittent. The iron must be very fluid and it is best to have it soft.

Stove plate scrap is recommended when the operations are carried on continuously, which will give you the proper composition for this line of work. The permanent molds should be made from a still softer mixture, which will withstand the heat better than a hard iron. You can use any scrap with the exception of car wheel or white iron, and sufficient silicon should be added to soften the mixture. It is somewhat expensive to use pig iron for this class of work.

Blow Holes From Chills

By W. J. Keep

Question:—We are making crossheads for ice machines, and we are compelled to use a chill on the casting, where the threads are cut for the connecting rod. This is done to close the grain at this point, and considerable trouble has been experienced with blowholes where the chill is used. We have coated the chill with oil and plumbago, and have also tried core wash, shellac and kerosene, as well as heating, but to no avail. We would like to know how the chill should be prepared to avoid this difficulty.

Answer:—You have tried about all the preparations ever used on chills, and it looks as though the trouble were somewhere else. The less you put on the chill, the better. Any foreign substance must burn off, and is likely to form blow-holes on account of the gas forming as it burns. All you need is to prevent moisture settling on the chill. The best preparation is black machine oil, or perhaps in your section you can get crude petroleum. Thin this with kerosene and rub over the chill, and you should have no trouble from blow-holes. Don't use any substance except oil alone. Any mixture that is affected by heat and must burn, will form gas and is a bad combination.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

FORMULAS FOR THE BRASS FOUNDRYMAN.

Yellow Brass for Sand Castings.

While the proportions of zinc that can be used in making yellow brass is susceptible of wide variation between certain limits, it is not advisable to run above 30 per cent when good, clean yellow brass sand castings are desired. A good, strong, freely cutting casting alloy is as follows:

	Pounds	Ounces
Copper	70	
Zinc	25	8
Tin	2	8
Lead	2	

First melt the copper under the usual cover of charcoal to a perfectly fluid condition, when the molten metal will appear clear and limpid. There must be no indications of mush or bubbling of the copper around the sides of the pot, but just a clear greenish orange surface. When this condition prevails, the zinc can be added without causing more than a slight hissing. Whenever the addition of the zinc is accompanied by a startling hissing noise, vivid light and much smoke, the copper has been overheated and burned, and the resulting metal will be of inferior quality and the losses high. Consequently, special care is necessary in melting the copper for yellow brass, and the zinc for the mixture should invariably be heated before being introduced into the copper. This may be accomplished by placing it on the furnace top, while the copper is being melted. It should be added to the molten copper in small pieces not more than 6 pounds in weight, and is lowered into the furnace with tongs and not thrown in, each piece being separately stirred to thoroughly incorporate the zinc and to avoid chilling the bath. After the zinc has been alloyed, the tin and lead are added, and should the metal prove too hard for the purpose for which it is intended, the quantity of tin can be diminished. When the addition of zinc is accompanied by the signs which indicate that the copper has been overheated, a deoxidizer should be used if high grade metal is required, and either iron or manganese is available for this purpose. If the former, use 1 per cent of yellow prussiate of potash. This should be wrapped in paper and lightly dropped upon the surface of the metal and allowed to remain until the water is driven off, the furnace being closed meanwhile. This may possibly take five minutes, when the potash is stirred in, the stirrer being cautiously inserted at first, to avoid possible danger of explosion.

Manganese may be introduced as manganese-copper in the proportion of one-fourth of a pound to 100 pounds of metal, and can be increased or decreased, as found necessary, to produce a pleasing brown color on the casting.

DATA SHEET, No. 77, THE FOUNDRY, NOVEMBER, 1910.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

FORMULAS FOR THE BRASS FOUNDRYMAN.

Bronze for Machinery Castings.

The general class of machinery castings may be taken to comprise all bronze parts used for engineering purposes that do not require a special alloy, and includes a multitude of castings of every imaginable shape and size, except those used for bearings or where great strength or other qualifications are demanded. For all purposes, where a good, reliable, easy casting bronze is required, of a rich gold color, the following formula can be recommended:

	Pounds
Copper	88½
Tin	5½
Zinc	3½
Lead	2½

The copper is first melted under charcoal, then the zinc is added, next the tin, and lastly the lead, the metal being thoroughly stirred.

This alloy may be cheapened, if desired, by the addition of scrap metal, as for instance:

	Pounds	Ounces
Copper	66	6
Tin	4	2
Zinc	2	10
Lead	1	14
Scrap brass	25	

The scrap should be carefully selected if it is desired to produce an alloy of uniform quality, and should be of the same composition as the new metal. Consequently, scrap of unknown composition cannot be used in such cases. For the general run of castings, however, a little deviation is of no consequence. Therefore, purchased scrap may be used in any quantity up to 50 per cent of the mixture, the only care necessary being to select such pieces that experience has taught will be likely to be made of the same kind of bronze.

DATA SHEET, No. 78, THE FOUNDRY, NOVEMBER, 1910.

THE BRASS FOUNDRY

A Progressive Aluminum Foundry

By F. B. Lucas

THE foundry herewith described is located in the vicinity of one of the largest manufacturing centers in New England. The original shop was started in a small town, two or three miles from its present location, under the direction of the present owner, who was at that time the chief melter, foreman and business manager. The entire plant was located in an old barn, about 20 x 30 feet, and although the roof did not leak, when the wind was from the northeast, the boys used to pack core sand in the cracks around the doors and windows and crowded as near to the small gas-fired furnace as possible. The coremaker's bench was a barrel, stood on end, and as soon as one casting was poured, he would hurriedly remove the gaggers and bent hooks for the next core, as the supply of this foundry equipment was limited.

The sand for the cores was dug out of a nearby hill, and when the castings were ready to be cleaned and the fins and sprues were to be removed, they were carried out of doors and this operation was performed on a box or barrel. All hands had to be present when pouring the mold, and on big jobs, three or four crucibles had to be poured at once, as no large pots were included in the equipment.

However, the crew, consisting of the owner, two first class molders, a coremaker and half a dozen faithful "rustics," produced a quality of aluminum castings that would have done credit to many of the larger and more modern foundries now in existence. It was a case of brains and ingenuity, mixed with good work, that soon resulted in the extension of the small foundry to a large, well-equipped plant of 15,000 square feet of floor space, employing 60 to 75 men. The reputation of this foundry for producing high grade aluminum castings soon became widespread. Recently, this concern began the manufacture of magnalium castings, which are lighter than aluminum.

Molding Machine Equipment.

The molding machine equipment consists of four squeezers, three Tabor hand-rammed, air draft roll-over molding machines and three, small, power-

FIG. 1—VIEW OF THE MAIN MOLDING FLOOR OF AN EASTERN ALUMINUM FOUNDRY, SHOWING A LARGE ROLL-OVER MOLDING MACHINE IN THE FOREGROUND

FIG. 2—THE ALUMINUM MELTING FURNACES

FIG. 3—MELTING FURNACES IN THE ANNEX

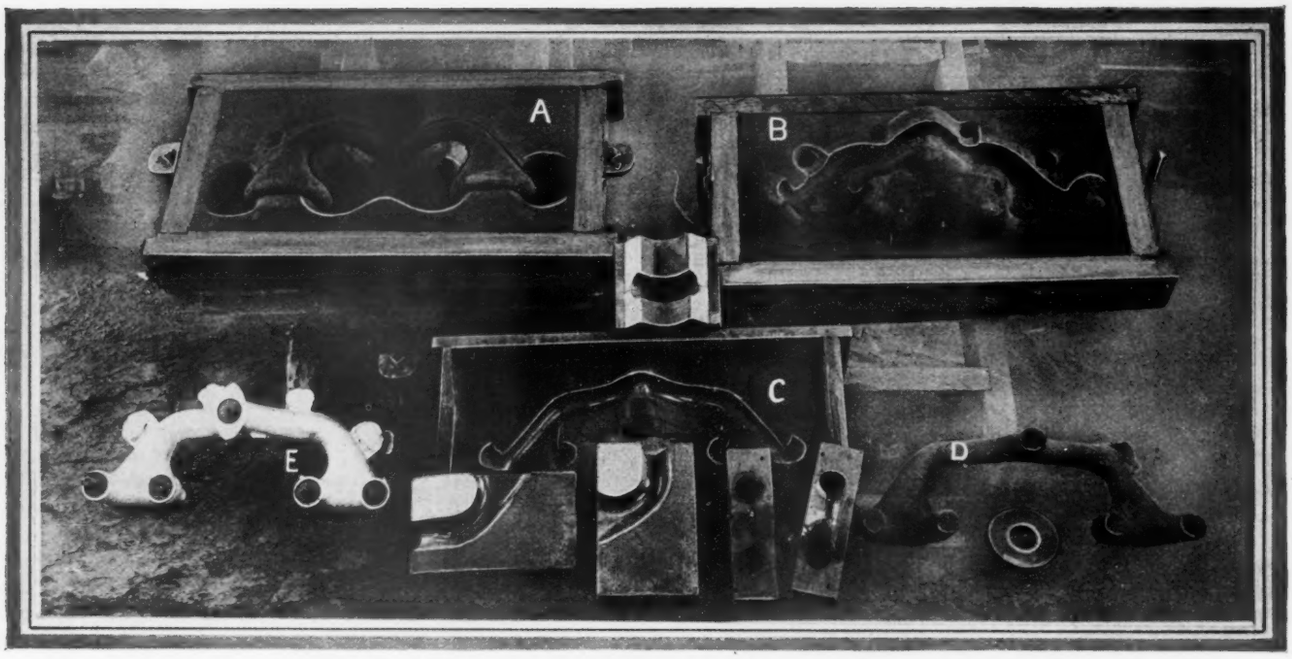


FIG. 4—COPE AND DRAG HALVES OF A MOLD FOR AN ALUMINUM INTAKE PIPE FOR A FOUR-CYLINDER GAS ENGINE, WITH COKE AND COKE BOX IN THE FOREGROUND

ramming molding machines. In the cleaning room is a 24-inch band saw, used for cutting off gates and sprues, as well as two pneumatic chipping hammers. The power is furnished by a horizontal gas engine of eight-horse-power capacity, an auxiliary engine and an air compressor have also been installed. The lighting of the shop is excellent, as, in addition to large windows on all sides, there is a monitor in the roof, which contains a double row of windows for lighting the center of the building. The plant has also been wired for electric lights, which are used on dark days and at night. These lights are distributed throughout the shop in an unique manner, as shown in Fig. 1, which is a view of the main foundry floor. The wiring cleats are fastened to the rafters and beams and from these the incandescent lights are suspended with extra long cords. About 2 feet from the lamps, a wire hook is attached to the cord and when the lamps are not in use, they are hung on a porcelain spool that slides on wire stretched across the shop. In all the foundry units the lights are arranged in this way.

Melting Furnaces.

In Fig. 2 are shown two batteries of furnaces in the main building. This group consists of six pit furnaces, located on either side of the chimney. At the left are shown a number of old crucibles that have seen their best days and at the extreme right, above furnace No. 12 is shown a pot, which has a record of 89 consecutive heats. The other crucibles average from 50 to 70 heats, respectively. The furnace covers are manipulated by long handles and hard coal is used for fuel. In this shop, the aluminum is fluxed with chloride of zinc. Another set of furnaces in the annex is shown in Fig. 3, as well as a pile of castings just shaken from the sand. Among the castings produced in this shop are sections required in the construction of flying machines, automobiles and for marine and government work.

Automobile Casting.

In Fig. 4 is shown the mold and parts that are required to make an intake pipe for a four-cylinder automobile engine. The drag half of the mold is illustrated at *A*, and *B* is the cope; *C* is the main part of the core box, and the five loose pieces are shown above and below the box, respectively. The core, which has just been made, is shown at *D*, and the cake core for forming the top of the flange on these castings is shown directly underneath the core. The finished casting before the removal of the gates and sprues is shown at *E*. When casting aluminum, it has been found in this shop that the cooler the metal is poured, the brighter the casting. However, care should be exercised to prevent the metal from chilling.

Aluminum Bearing Alloy.

A new, French, aluminum alloy, made in this shop, that is intended for use as a bearing metal in place of brass or bronze, is as follows: Copper, 1.2 per cent; tin, 12 per cent; lead, 0.8 per cent; aluminum, 35 per cent; antimony, 10 per cent; zinc, 41 per cent. The extreme limits of this mixture are: Copper, 0.4 to 1.25 per cent; tin, 10 to 15 per cent; aluminum, 15 to 35 per cent, and zinc, 30 to 55 per cent. This mixture is made by first melting the copper and then adding other metals as noted. With each new addition, the mixture should be carefully stirred with an iron bar, and toward the end of the melting operation the metal should be stirred with a stick to insure a uniform mixture.

Machinery Castings

By W. J. Keep

Question:—Please give us an analysis of a mixture for machinery castings, averaging from 100 to 500 pounds each. The iron we are using contains silicon, 3.50 per cent, manganese, 1.20 per cent, sulphur 0.035 per cent and phosphorus 0.90 per cent. We would like to know the analysis of the pig iron that we should mix with the iron we are now using.

Answer:—The weight of the castings naturally conveys no idea of the cross-section. However, ordinary machinery mixtures should contain about 2.25 per cent silicon, and we would suggest that you add from 50 to 60 per cent of machinery scrap to the iron which you have in your yard. If you were to use pig iron exclusively, it should be more economical to purchase iron containing 2.50 per cent silicon. The phosphorus should not be over 0.60 per cent and therefore you shou'd purchase an iron with phosphorus lower than 0.90 per cent.

IMPURITIES IN TOUGH PITCH COPPER*

Results of investigations to determine the effect of small quantities of bismuth, silver and aluminum upon the properties of copper when in the tough pitch state

THE proper quantity of oxygen in copper is the keynote of all copper refining. It is the presence of a well-defined proposition of oxygen in the form of cuprous-oxide, which enables copper to be cast free from blowholes. It seems that when oxygen is present, other gases are less soluble in molten copper, and when oxygen is absent or is present in insufficient quantity, the copper dissolves other gases, such as hydrogen and carbon monoxide, which are insoluble in the copper when solid, and being rejected during the process of solidification cause internal porosity and external ridges or excrescences. The object of this research was to discover the effects of certain impurities on copper when in the tough-pitch condition, that is, copper containing just sufficient oxygen to insure a level surface and soundness in the casting, and imparting to it physical and mechanical properties, which otherwise it would not have.

Experiments.

Since nearly all copper, except that required for electrical purposes, contains a small quantity of arsenic, and much of it undergoes mechanical treatment at a red heat, the author determined to use for his experiments pure electrolytic copper to which an approximate proportion of arsenic was added. The ingots were hot-rolled and were reduced to rods in one heat and mechanical tests were made to ascertain the influence of impurities on the tensile strength and extensibility, the resistance to bending, the resistance to alternating stresses and their malleability. The ingots were cast in molds formed by four pieces of iron, 1¼ inches square, two pieces being 13 inches long, and two pieces, 3 inches long. They were arranged on a flat brick tile, so as to form a space, 6½ x 1¼ inches. The brick tile was preferred to iron, because of its freedom from scale or rust, and was also a poor conductor, permitting the metal to cool slowly. The mold being open, made it possible to judge the pitch of the copper from the appearance of the surface of the ingot, a most essential feature of the work.

*Abstract of a paper presented before the Institute of Metals, by F. Johnson, at the autumn meeting of this organization.

The copper was melted in an ordinary furnace, 9 inches square, in clay crucibles, the metal being introduced as clean cathode copper of 99.90 per cent purity. The arsenic was added as a rich alloy of copper, and the other metals were also in the purest forms obtainable. The contents of the crucibles were always well stirred with an iron poker, which was clay encased, to protect the copper from iron contamination. After the copper was melted, samples were taken and its condition judged from the appearance of the surface, when solidified. If the ingot showed a depression the copper was under-pitch, and some oxygen had to be eliminated by further poling. If it showed a level surface the metal was judged to be at the tough-pitch stage and was immediately poured into the mold. If it showed a convex surface the copper was over-pitch and more oxygen had to be admitted by allowing the air to play on the exposed surface of the molten metal. The usual method of taking samples is by dipping out some metal by means of a small iron ladle. The author tried this and discarded it because of the necessity of getting the ladle hot, which consumed much time and also involved the risk of introducing iron. The method adopted was to pour the metal into the ladle, returning the crucible to the furnace each time, and all under, or over pitch samples were returned to the crucible. This method of testing the pitch of the copper by taking small samples is by no means infallible. It was found necessary to rely upon the appearance of the ingot when set, to judge whether it was suitable for further investigations. If it showed a marked longitudinal depression it was rejected as being under-pitch. If it showed a ridge, it was rejected as being over-pitch. Only ingots exhibiting a surface practically dead level were submitted to rolling or subsequent tests. It was found advisable to have the metal quite hot, to insure fluidity when pouring, to avoid skulls of metal in the crucible and the dangers of cold-setting in the molds. This was not always an easy matter, as the operation of bringing to pitch often took a considerable time, and to replenish the fire in the furnace entailed lowering the temperature of the crucible and its contents. Often it became necessary to close up the furnace in order to regain lost heat, by which time the contents of the crucible had invariably gone under pitch, and the tests had to be repeated.

Rolling the Ingots.

The ingots after casting, were reheated to a bright red heat and rolled in eight passes to rods measuring 8 feet x ½ inch diameter, finishing at a dull red heat. The rods were numbered, and pieces cut from them for the various mechanical tests, and pieces for analysis were cut as close as possible to the test pieces.

Bending Tests.

When making the bending tests, the rods were fastened upright in a vise, with 2 inches projecting from the jaws, and were hammered over to an angle of 90 degrees. They were then taken out and doubled in the jaws until a crack developed. If no crack appeared, the doubling over was completed through the entire angle of 180 degrees; the rods were tested as rolled, and the only bars to fail in this test were those under-pitch or over-poled.

Alternating Stress Test.

Alternating stress tests were made by Prof. J. O. Arnold of the University of Sheffield. Rods, 6 inches long, were turned down to ⅜ inch diameter and tested as rolled. They were fastened rigidly in the stationary die of the machine, in a vertical position, and were submitted to alternating stresses, by being bent to and fro, ⅜ inch from the vertical, by a slotted arm worked by an electrically-driven eccentric. The number of alternations was automatically recorded by a mechanical register. When the specimen broke the rate of alternating was 650 per minute, and two strokes of the moving arm constituted one alternation to and fro. The value of this test for copper cannot be too highly rated. It reveals, in a trustworthy manner, any defect in the pitch of the metal, not only in the lower number of alternations, which under or over-pitch copper will endure, but also in the appearance of the fracture, which in tough-pitch

copper appears very pale and silky, with a fine line running across the center, at right angles to the direction of stresses. This is the final line of fracture and varies with the condition of the copper, being broader when the metal is under-pitch. Thus, a pure copper containing 0.066 per cent of oxygen withstood 190 alternations before it broke. The fracture was silky, the central line, 0.01 inch broad, and the top of the ingot was level. A sample of under-pitch copper contained 0.182 per cent oxygen, broke at 122 alternations and several subsidiary lines showed in the fracture, which appeared dry instead of silky. The tests showed that the effect of bismuth was to lower the resistance of arsenical copper, whether it was in a tough-pitch or under-pitch condition.

Tensile Tests.

In the tensile tests, the sample of tough-pitch copper, containing 0.066 per cent oxygen, broke at 35,300 pounds, with an extension in 3 inches of 51 per cent, as against 33,500 pounds for an under-pitch copper containing, 0.089 per cent oxygen. The tests showed that the copper was strongest when the oxygen ranged from 0.052 and 0.066 per cent. All the tough-pitch arsenical specimens show improved mechanical properties over the arsenic free, tough-pitch specimens, which underwent exactly the same treatment. The presence of arsenic also tends to lower the proportion of oxygen necessary to make the copper tough-pitch, as without arsenic about 0.08 per cent is required, while the arsenic 0.06 per cent seems to be sufficient. Silver in the presence of arsenic does not impair the hot working properties up to at least 0.175 per cent. It increases the tensile strength and raises the elastic limit, and hardly affects the ductility or resistance to alternating stresses. The effect of bismuth on the hot working properties is detrimental even in the presence of arsenic, but up to 0.05 bismuth, if 0.3 to 0.4 per cent arsenic be present, the effect is not absolutely ruinous. In tough-pitch arsenical copper, it raises the tensile strength and extensibility, but lowers the elastic limit and resistance to alternating stresses. Tough-pitch copper, free from arsenic, is unfitted for rolling hot if it contains 0.02 per cent bismuth.

Aluminum as a Deoxidizer.

When tough-pitch copper is deoxidized by aluminum, its hot-working properties are not inferior to those of the standard tough-pitch bars, but its tensile strength is lower and its ductility and resistance to alternating stresses are slightly higher. This shows that when a lower proportion of oxygen is present than is necessary to make the copper tough-pitch, its ductility is increased at the expense of tensile strength. When too much aluminum is used the hot-working properties of the copper are destroyed, the resulting rolled material being in a deplorable condition, the surface being defective from end to end. It is evident, therefore, that aluminum and arsenic, although each alone has its beneficial effects, are to be avoided together in copper. The percentage of aluminum that produced these latter effects was 0.320, with 0.300 per cent arsenic.

It was clearly developed that all three of the impurities—silver, bismuth and aluminum,—have very marked effects on the mechanical properties of arsenical copper, and are more apparent in tests of hot-rolled than in those of cold-worked and annealed material. The effect of silver in the proportions usually found in commercial tough-pitch arsenical copper may be considered as beneficial on the whole as regards mechanical properties, and negligible as regards hot-working properties. The effect of bismuth is not serious up to 0.10 per cent, but no commercial arsenical copper could be regarded as fit for working at a red heat which contained so much bismuth. Any crude copper containing over 0.01 per cent bismuth should be regarded with suspicion, since the copper might contain other impurities, such as nickel, which would intensify the injurious effects of the bismuth, and retard the corrective action of arsenic. Arsenic and oxygen both aid in improving the mechanical properties of copper containing bismuth. The effect of aluminum in arsenical copper is to destroy its hot-working properties and to impair it physical properties in the cast, and its mechanical properties in the rolled condition.

The Brass Scrap Pile—II

By C. Vickers

SILICON has of late replaced aluminum in certain classes of castings, when fluidity and freedom from smoke is desired, and when the castings are too heavy to run perfectly clean with aluminum. The use of silicon, however, is limited to such castings as can be made without lead, as the addition of the latter metal spoils the alloy for sand casting purposes. This can be proved by the following experiment: Melt 10 pounds of copper, add 7 pounds of zinc and 6 ounces of silicon-copper Run into sand castings; tensile strength 50,000 pounds per square inch. Then re-melt the gates, and to every pound add 1 ounce of lead, and run into a sand test bar. The appearance of this bar will clearly indicate the kind of trouble which will follow the extensive use of silicon in copper alloys. Silicon is also used in tin bronzes, for making trolley wheels, and these castings cause more trouble to the brass founder than the yellow alloys, because they contain a much greater quantity of silicon. One or two trolley wheels containing 5 per cent of 10 per cent silicon-copper and 5 per cent tin, are sufficient to spoil an entire heat of bronze. When this occurs, the surface of the metal will be mirror-like, with a lazy, viscid appearance, and a sample casting should be made in sand, which will show whether aluminum or silicon causes this appearance. If the former, nothing can be done, and the metal will have to be used up according to the discretion of the founder. Silicon, however, can be removed in the crucible with plaster-of-paris, but the process is a tedious one, the best way being by the addition of magnesium, sodium and copper oxide. This method is very effective when the bronze is leaded, and completely restores the metal to its original color and beauty.

Iron in Scrap.

The scrap metal dealer who purchases a lot of trolley wheel scrap, containing silicon, will be very liable to find this material thrown back on his hands. The troubles we have been considering are caused by either silicon or aluminum in red or yellow brass. Other unfamiliar metals are iron, titanium, sodium, manganese, vanadium, magnesium, and also

the very familiar metal, lead. Iron is the scrap metal dealers' trouble-maker, and aided by his two faithful friends, the file and the magnet, he searches for it, and then often fails to find it. So he is always busy hammering and chiseling out little screws and rivets that escaped his observation or that he was "allowed for" when buying. But the iron that is invisible does not bother the scrap man, because he cannot see it; neither can the purchaser, and if he complains later, how can he prove that the poker didn't melt off? It is a live issue, however, for the foundryman, as metal with iron in it can only be used on cheap castings. There is no way of removing the iron in the brass foundry, once it assumes the form of hard spots, but every brass founder has ways of getting rid of it, particularly if he makes car brasses. When iron is properly alloyed with copper, it causes no particular trouble either on the scrap pile or in the foundry, as the percentage is small and it does not even blacken the castings. About 4 per cent iron has been found to produce the strongest alloys, the tensile strength being about 45,000 pounds per square inch, and the color that of copper.

Titanium.

Titanium is so little used at present that it does not need to be considered, and is mentioned here merely to allay any fears that might arise regarding it. Titanium aids brass to dissolve iron and to maintain its color. Experiments with 12 per cent ferro-titanium have shown that even when present in large amounts in copper, the content of iron does not in any way affect the color of the castings, and this element can be used in connection with iron, as a ferro-alloy, to produce rich colorings on bronze castings; but whether the use of titanium copper, free from iron, will restore the beauty of iron-blackened bronze, the writer is not prepared to state, but it is an interesting field for experiment. Titanium, then, is an influence for good, as it increases the strength of copper and its alloys, and does not produce any casting difficulties.

Sodium.

Sodium is very little used. It is a powerful deoxidizer, and makes a better bronze than phosphorus, but causes no trouble at all, either to the metal dealer or to the founder.

Manganese.

Manganese has scarcely been used in bronze in sufficient quantity as yet to cause trouble. In small amounts, it is a very valuable deoxidizer, but should be used only in fractions of a per cent for this purpose. Manganese gives brass castings a brown color, which varies from a light brown to a dirty sepia. It also affects the running qualities of the metal so that the castings are badly cold shut. Phosphorus will overcome this difficulty. In alloys not heavily leaded, small quantities of manganese can be detected in brass castings by an inspection of the head of the sprue, where it shows as a broad band of a Van Dyke brown color; on the tapered part, where it has been protected by the sand. This discoloration appears, sometimes accompanied by a shrinkage hole, even when the percentage of manganese was insufficient to discolor the castings.

Vanadium and Magnesium.

Of the two metals, vanadium and magnesium, the former has been very little used. In bronze, the writer has made no tests with it and cannot speak from experience regarding its effects. Magnesium, however, used in quantity, greatly impairs the casting qualities of bronze. It makes yellow brass a dirty black color, one-half ounce of magnesium being sufficient to spoil 15 pounds of yellow brass. It should be used for deoxidizing purposes only, and in small fractions of a per cent. It is not likely to be encountered in scrap metals in sufficient quantity to cause any anxiety, either to consumer or dealer. Properly used, it is a very valuable deoxidizer of copper and its alloys.

Copper-Lead Mixtures.

The extensive modern use of the copper-lead mixtures for bearings, and other moving parts of machinery, where their anti-friction qualities are invaluable, entitles them to be looked upon as a new series of alloys, in view of which it will not seem strange to classify lead with the little known metals just considered. Alloys of copper and lead are quite ancient, and were formerly known as pot metals, but the content of lead was comparatively low, and never ran above 1 part lead to 2 parts copper, which is equivalent to 33-1/3 per cent. This was considered the limit in those days, and on account of the difficulty experienced in retaining the lead, due to its oozing out, it was known as wet pot metal. This alloy found little application, as even when successfully cast, it was too short to be of much service. In the uses to which these alloys were then put, an alloy of copper 16 parts, lead 6 parts, was more frequently used, under the name of cock alloy, or dry pot metal. The first name indicates the use to which these alloys were put, and the second signifies that it was possible to cast it without the lead oozing out. It is doubtful if even in these days these alloys were made exclusively of copper and lead, as mention is made of the fact that a little tin improves the alloy, while arsenic was frequently used, and an idea seems to have been prevalent that the lead should be "killed" by alloying with arsenic, before being added to the copper, to prevent liquation. It is evident, therefore, that the modern methods of making these alloys were unknown, and also that these "pot metals" and "cock alloys" were not made in sufficient quantity to become noticeable to the scrap dealers.

Leaded Alloys.

In the present age of highly leaded alloys, it is no uncommon thing for the content of lead to reach 50 per cent of the total mixture, and sometimes even higher, while many tons of bearings, running from 20 to 40 per cent lead, are made annually. This means that the scrap pile of the future will be heavily leaded, and that some means must be adopted in the not far distant future, of distinguishing between these metals and the bronze and composition alloys they resemble. The identification and classification of brass is a very easy matter because of the yellow color, which begins to show with 15 per cent zinc, and at 25 per cent is a full yellow, continuing until at high percentages of zinc the red colored alloys are encountered, and which, as before stated, are only troublesome as scrap, to the founder, when they contain aluminum or silicon, or are present in too great quantity.

Bearing Scrap.

Copper and lead alloys, particularly when the lead is no higher than 30 per cent, are difficult to distinguish from bronze when in the shape of scrap. This is especially the case when the alloy contains a small quantity of tin, and the bearing has become worn; then it appears like good tin bronze, and receives respectful consideration as such, but its intrinsic value is less than ordinary yellow scrap because of its high content of lead, and great weight. While the copper and lead alloys are not as easy to identify as yellow brass, there are various means by which they can be recognized by anyone possessing the necessary skill. These tests comprise indentation with a hammer, cutting with knife or chisel, examination of the fracture, judging by the weight, or heating until red hot. The latter is the most satisfactory test, and is based on the fact that the lead liquates when the metal is slowly brought to a red heat,

and the casting is covered with a lead sweat, which can be taken as a sure indication that the alloy contains over 20 per cent of lead. This is easily applied in the brass foundry, as the suspected pieces of scrap can be laid on the sides of the pot until red, and if there is no sweat, the metal can be used as bronze or composition scrap without great risk. The metal dealer cannot apply this test so readily, but in cases where large quantities of scrap bearings are for sale, it would be a good idea to insist on samples being heated before a bid is made.

Gating Brass Valves and Fittings

By Frank R. Zeller

THE present day brass foundry foreman has many problems to solve arising from the use of molding machines, oil melting furnaces, cheap metals, and the replacement of skilled mechanics, to a large extent by handymen and laborers. In the past the molder's day's work was comparatively small, and time was given to carefully temper the sand and vent the molds. At present, with a single machine producing from 100 to 200 molds a day, the same time cannot be given to the sand by the molder as was formerly the case.

This is true also of melting, pouring and handling the metal, which must be done quickly and at a low cost. Therefore, owing to the rapidity with which the work must be turned out, it is plainly the foreman's duty to devise methods and equipment which will eliminate skill and reduce manual labor as much as possible. As conditions vary in different shops it is not feasible to suggest methods which will apply everywhere, therefore it is largely left to the foundry manager to adopt such methods as are consistent with his practice.

The sand must receive due attention and patterns must be correctly plated for machines; set sprues should be used and gates properly proportioned, and whenever possible, they should be fastened to the plates, to avoid the necessity of cutting or retouching, thus reducing skilled work to a minimum.

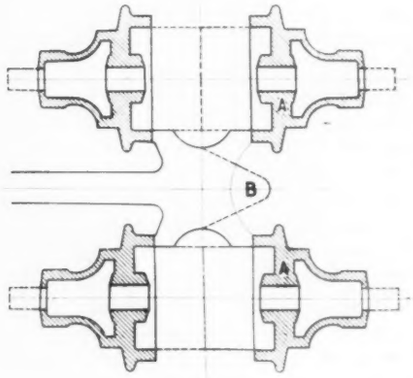


FIG. 1—PROPER METHOD OF GATING GLOBE OR ANGLE VALVES.

Gating Patterns.

When gating patterns, the gates should be placed so that they can be easily removed, thus reducing the cost of cutting-off and cleaning the castings. Fig. 1 shows the proper method of gating a globe or angle valve, and it will be noted that the gate is small at the casting, and gradually tapers outwards in width and thickness. The valve is shown gated on the hexagon end, at the back, and the core is set so that the partition comes next to the gate. This is an advantage because the opening in the core permits the mold to fill more rapidly, thus lessening the danger of cold shuts. Valves should never be gated on or near the bonnet end, because of the small sand pockets, which are liable to wash.

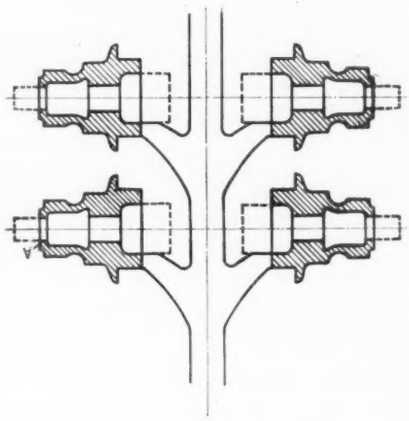


FIG. 2—IMPROPER METHOD OF GATING

Defective Valves.

The leakage of valves and fittings, while being tested under pressure, is frequently an annoying source of loss to the manufacturer. This is very expensive because the castings have been finished and assembled. These leaks generally occur at the neck, and an impression is prevalent that they are caused by a draw or shrinkage. That this is not the case will be seen upon changing the gate. This does not remove the source of trouble, as the leaks continue, but they follow the gate, and are always found near this point. Therefore, it is apparent that these leaks are caused by dirt or dross, which has been carried by the metal and passes through the runner and gate, through the hexagon nut, but when it reaches the lighter part of the valve it lodges between the core and the mold. If dross is in the metal it cannot be detected until the casting is tested under pressure. The nature of the defect can be very easily determined by marking the place which leaks when the valve is tested, and by cutting on either side of the mark, the casting can be broken at the point of leakage and the fracture will disclose the cause of the trouble.

The bonnet castings shown in Fig. 2 should not be gated on the small end, *A*, as the gate is liable to break off and tear out the part overlapping the core. The proper manner of gating is shown in Fig. 3, and when there is danger of shrinkage, caused by bars or heavy parts, as in *A*, Fig. 1, a shrink ball should be used, as indicated at *B*.

The Metal.

Scrap brass is used to a large extent because of the beneficial results of remelting and also because there is supposed to be sufficient tin in the scrap to avoid the necessity of adding

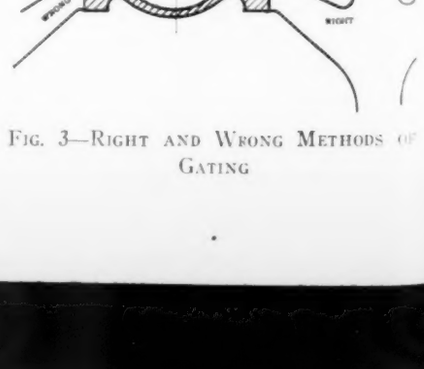


FIG. 3—RIGHT AND WRONG METHODS OF GATING

it to the mixture. In recent years, however, it is doubtful if much of a saving is effected by the use of scrap because much of the metal which finds its way to the scrap pile is of cheap composition, well dosed with lead, and contains very little tin. Good results can be obtained, however, providing good judgment is used in sorting the scrap, although it is very difficult to get a good color on the castings. The following mixtures, using scrap, will give good results:

No. 1, used for valves,

	Pounds.
Scrap brass (red)	75
Scrap brass (yellow)	14
Copper	8
Zinc	2
Lead	1

No. 2 is cheaper and is used for trimmings and ordinary castings. The mixture follows:

	Pounds.
Scrap brass (red)	73
Scrap brass (yellow)	18
Copper	4
Zinc	3
Lead	2

If it is desirable to use all new metals, the following mixtures are reliable:

No. 3, used for valves and hydraulic castings: Copper 84 pounds, tin 10 pounds, zinc 4 pounds, lead 2 pounds.

No. 4 is a little cheaper and is excellent for high pressure castings. This mixture follows: Copper 87 pounds, tin 7 pounds, zinc 4 pounds, lead 2 pounds.

No. 5 is an ordinary steam metal of good strength and color, and is made up as follows: Copper 88 pounds, tin 5 pounds, zinc 3½ pounds, lead 3½ pounds.

No. 6 is a cheap metal of good strength and color, and is suitable for ordinary castings. This mixture follows: Copper 87 pounds, zinc 9 pounds, tin 1 pound, lead 3 pounds.

Discussion of Brass Foundry Practice by the Institute of Metals

AT THE autumn meeting of the Institute of Metals, held at Glasgow, Scotland, papers, especially those dealing with brass founders' alloys, published in abstract in the October issue of THE FOUNDRY, were discussed at length. "Magnetic Alloys Formed from Non-magnetic Materials," was first considered. Professor Gray said that the paper was part of a large series which had been worked out in the laboratory of the Glasgow University. For instance, it was found that a manganese steel, which was supposed to be entirely non-magnetic, could be made highly magnetic by proper treatment. The view that an alloy of that kind was a perfectly definite thing which retained its properties under all conditions was entirely wrong. Some specimens of copper, furnished for these experiments as chemically pure, were found to contain minute quantities of iron. This was carefully analyzed and the amount of magnetism present was found to be many times greater than what could be expected from this amount of iron of even the highest permeability. It was clear, therefore, that iron so present had an effect upon the structure of the metals forming the alloys.

E. L. Rhead, Manchester, said that two students working in his laboratory found that certain groups of metals were perfectly active in conferring magnetic value. Zinc and cadmium gave a considerable amount. The most remarkable effects were those obtained with the groups in which antimony and bismuth were found. It was concluded that phosphorus and arsenic, added to manganese, had the same effect, though not in similar proportions.

Heat Treatment of Brass.

In the discussion of the paper on "The Heat Treatment of Brass," prepared by G. D. Bengough and O. D. Hudson, Professor Turner called attention to the subject of maximum annealing. He stated that over-annealing and burning were quite distinct. The author of the paper had shown clearly that so-called burning was not due to oxidation and he thought that probably experiments in a reducing atmosphere would be conclusive on that point. Dr. Desch said that he had long been of the opinion that critical changes took place at about 500 degrees Cent. in copper-arsenic alloys. F. Johnson said it was clear that 70:30 brass could not be expected to retain its original strength if used where the temperature would reach 300 degrees Cent. Regarding the volatilization of zinc, he asked whether this would extend through to the core and believed that tests at high temperature would prove of great value. He considered burnt metal one upon which the flame from burning fuel had been allowed to impinge, causing local over-heating. J. J. Edwards said that he dealt extensively with 70:30 brass and had considerable experience with annealing. He considered that about 630 degrees Cent. was an ideal temperature for annealing brass. This temperature might be raised to 800 degrees Cent. without doing serious damage. H. H. A. Greer said that the metal which had been characterized as burnt was not exactly what was recognized as such in Glasgow under that name. Burnt metal with gun metal and tin alloys is considered a metal so produced by oxidation. O. F. Hudson, replying, stated that he was convinced that there was some very definite changes at about 400 degrees Cent.

Shrinkage of Alloys.

In the discussion of the paper on "The Shrinkage of the Antimony-Lead Alloys and Aluminum-Zinc Alloys, During and After Solidification," Professor Turner pointed out that white cast iron does not expand, but gives a uniform curve. However, if silicon is added to the iron, graphite is eliminated and the curve of expansion rises sharply.

In the discussion of a paper entitled, "The Effect of Silver, Bismuth and Aluminum Upon the Mechanical Properties of Tough Pitch Copper Containing Arsenic," Professor Turner pointed out that electrolytic copper and wrought copper were totally different in composition and that exposure to the air might have a very important oxidizing effect. E. L. Rhead said that antimony was usually supposed to be harmful, but it is undecided at present whether it is as harmful in copper as bismuth. Sir William White considered that the question of the effect of introduction of impurities was of immense value. He did not doubt but that in metallurgical operations, England had not advanced as far as Germany. However, considerable progress is now being made, and he was satisfied that manufacturers are making rapid headway. F. Johnson, replying, said that it was generally found

that if arsenic were added in a refining furnace, where oxygen is not permitted to be present, the tensile results are greatly improved. The effect of pressure on molten copper, he added, was very much in doubt at the present time, and required further investigation.

Defects in Alloys.

In the discussion of the paper by Cecil H. Desch, on "Some Common Defects Occurring in Alloys," G. A. Boeddicker called attention to the exhibition of diseased metals which it was proposed to hold in London, and which would certainly prove of great value. He believed that diseases should be classified under medical and surgical heads. Medical cases might be regarded as those resulting from bad composition, and surgical as injuries caused by oxygen or carbon. Many defects, such as sponginess, were generally found to be due to the presence of a considerable amount of oxygen in solution, and which, at high temperatures, reacts on the graphite in the crucible, producing monoxide, thus causing the metal to be spongy. E. L. Rhead regretted that the great value of metallographic work was not recognized and adopted by manufacturers on the ground, as they thought, it was too difficult to carry out. He was of the opinion that the microscope would point out the difference between good and bad material, and to this extent would aid in improving the nature of the material. Mr. Primrose said that there is no doubt of the value of the microscope as an aid to the brass founder. He also found that when blow-holes in castings appeared dirty, they were due to oxide inclusions, but when they were clean they were found to be due to the steam in the mold, formed by running the metal when the mold was not perfectly dry.

Brass Foundry Difficulties

SOLVED BY EXPERTS

Journal Bearings

We are considering the installation of a brass department for making journal bearings and light brass castings, and we would like a suitable mixture for this class of work. We would also like to know the approximate loss during the melting process.

Unless you make the journal bearings of red brass scrap, you will require a special mixture for the light castings. The following is recommended: Copper, 87 per cent; zinc, 6 per cent; tin, 4 per cent, and lead, 3 per cent. Journal bearings are generally made of the cheapest kind of scrap that can be procured, which consists largely of yellow brass. An alloy that can be recommended when a better grade of bearing than ordinary is desired, is the following: Copper, 76 per cent; tin, 8 per cent; lead, 15 per cent, and phosphor-copper (15 per cent), 1 per cent. Bearing alloys should contain high percentages of lead to minimize heating difficulties. An excellent metal for this purpose is plastic bronze. This metal contains 30 per cent lead, 65 per cent copper and 5 per cent tin, and is patented by the Ajax Bronze Co., Philadelphia. Another alloy that has given good results is manganese bearing bronze, the formula for which was given in Data Sheet No. 71, in the August, 1910, issue of THE FOUNDRY. Should you experience trouble in making this alloy, however, a cheap metal that is very often used, follows: Copper, 70 per cent; zinc, 11 per cent; lead, 15 per cent; tin, 4 per cent. The shrinkage or loss during the melting process will vary, according to the skill of the melter, but can be figured as excessive if it runs much over 3 per cent.

Pattern Bronze

We would like a good bronze mixture for metal patterns. We can obtain considerable work of this kind but our castings, although good, do not possess the fine finish demanded by the trade.

An alloy that can be recommended for making bronze pattern castings is as follows: Copper, 90 pounds; tin, 5½ pounds; zinc, 3 pounds; and lead, 1½ pounds. The use of a suitable metal does not necessarily imply that the castings will be satisfactory, as there are other factors which have an even greater influence upon the product, and must be taken into consideration. Chief of those is skill in workmanship, although suitability of sand comes a close second; but a skillful molder will turn out presentable castings in rough sand, while a poor workman may be given the finest sand procurable, and still make coarse and unsightly work. Therefore, there must be a combination of skill in molding, the best and most suitable sand, and a clean-running metal, possessed of the highest casting qualities. The first requisite can generally be procured if sufficient inducement is offered, and in this connection it should be remembered that careful work consumes time, and the man who is intrusted with it, should not be expected to compete in output with a molding machine. When it comes to procuring sand, consideration of extra cost should not be permitted to intervene to the exclusion of the finer and most suitable grades, or the appearance of the castings will show it, and there will always be something about them that will prevent their being regarded as "first class."

Scrap Aluminum

In melting scrap aluminum turnings from automobile transmission boxes, we find, that while there is some aluminum in the crucible, the most of it comes to the top and looks like saw dust. We think some other metal must have been added to the turnings to cheapen them, as we buy them outside. We would like to have a formula suitable for trolley wheels, an alloy that will wear well, as these are for a test.

It is very unwise to purchase aluminum turnings for foundry use. In fact, if they were procured for nothing, the castings would probably cost more than if made from new ingot metal. This is due to several causes, chief of which is the difficulty of melting the metal when in a finely divided state, because of the large loss from oxidation. Furthermore, the aluminum used in such castings is always an alloy, generally of aluminum and zinc, and the latter metal being highly oxidizable when in a finely divided state, increases the difficulty of melting, by greatly favoring the formation of dross.

A third trouble is due to the iron most always present in metal turnings, which readily alloys with the aluminum when the latter is melted, making it brittle and useless. It is, therefore, necessary to remove all the iron chips from the aluminum turnings, either with a magnet, or by passing them through a separator. This should be the first step taken to use the turnings. After they are cleaned, melt down 20 pounds of aluminum ingot, and when at a cherry red heat, add 10 pounds of turnings, gradually stirring them into the melted metal, as fast as it will take them. If there is any mush on top of the crucible, reduce with chloride of zinc in the solid form, and if this is not readily obtainable, purchase a bottle of soldering salts, adding one teaspoonful to each pot and cautiously stir it into the dross, which will be reduced to a dust. In this manner the chips can be used, keeping the proportions as given—two-thirds new metal, one-third chips.

An alloy for trolley wheels follows: Copper, 92 pounds; phosphor-copper, 3 pounds, and tin, 5 pounds.

Condenser Heads

We would like to obtain a formula for a good alloy for steam condenser heads.

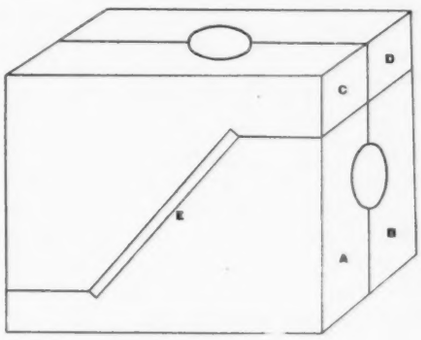
The following can be recommended: Copper, 85 pounds; tin, 8½ pounds, and zinc, 6½ pounds. As this alloy is somewhat difficult to machine, it can be modified as follows: Copper, 85 pounds; tin, 8½ pounds; zinc, 4½ pounds, and lead, 2 pounds. The latter alloy, however, is not as strong as the first, owing to the weakening effects of the lead. These alloys should be cooled as rapidly as possible after they are cast, as slow cooling is conducive to the formation of large crystals. These attach themselves to the surfaces cooled by the sand, and grow inward, draining the eutectic from the center of the casting, thus producing a lateral fissure, which appears as a split when the metal is broken and the fracture examined. Cooling can be affected by removing the cope as soon as the metal is judged to be set. In doing so, it is advisable to punch out some of the sand so that the casting is covered. This should not be immediately shoveled off, otherwise the casting may bleed upwards, which phenomenon is caused by the exudation of the rich and very fluid copper-tin eutectic. After the removal of the copper, sprinkle the casting with water, carefully at first, then more copiously as the red color fades and the danger point recedes. When the redness has vanished, roll over and remove the drag and sprinkle the casting until sufficiently cool to be handled.

Making Globe Valve Cores in One Piece

By B. Storm

THE margin of profit in the manufacture of globe valves is so small that advantage must be taken of every labor-saving method. Most of the modern equipment has been designed to simplify and reduce the cost of molding and finishing castings. In the production of these somewhat difficult cores, the progress has not kept pace with the improvements in other directions, and even large valve manufacturers adhere to methods that give comparatively poor results.

The core box illustrated has been found to produce from 50 to 70 per cent more cores than can be obtained by making them in halves and pasting them together. An even greater advantage is that they are correct and uniform in size, and as they are made in one piece, they produce a smooth, finless cavity, so difficult to obtain, and yet so necessary in these castings. This is due to the core box, which consists



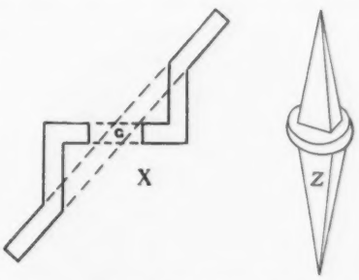


FIG. 1—THE CORE BOX; SECTION OF THE SEAT PRINT IS SHOWN AT *X* AND THE CAST IRON SPUR AT *Z*

of five parts, *A*, *B*, *C*, *D* and *E*, Fig. 1.

The most important part of the core box is the seat print, *E*, Fig. 1, which is also shown in section at *X*. The opening, *G*, in the seat print, forms the projection that joins the two sections of the core. This is the weak point of a valve core and has always proved an obstacle to making them in one section, as a wire always has a tendency to spring more or less, and fails to give the necessary rigidity. These troubles are entirely overcome by the use of the cast iron spur, *Z*.

To make the core, the parts of the box, *A* and *B*, are put together, and the seat print, *E*, is placed in position. This portion is then rammed with sand, the opening in the seat print being filled flush. The spur is next inserted as at *G*, Figs. 2 and 3. The parts *C* and *D* are then placed in position. Fig. 2 shows a section of the box at this stage, the parts *A* and *B* being shown rammed with sand and the spur in place. The parts, *C* and *D*, are then rammed up,

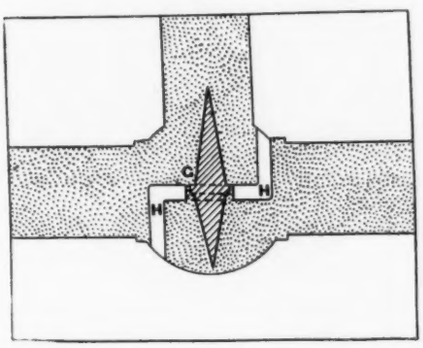


FIG. 2—SECTION OF THE CORE BOX, SHOWING THE SEAT PRINT AND CAST IRON SPUR IN POSITION

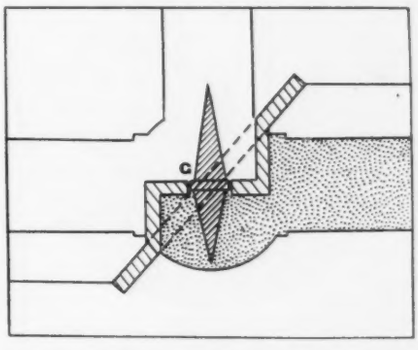


FIG. 3—SECTION OF THE CORE BOX, SHOWING THE FINISHED CORE WITH THE SEAT PRINT REMOVED

all vents being properly placed. This can be easily done from the open ends; *C* and *D* are next lifted off together, carrying the sand along; then remove the seat print, pick out the spur, dip in thin paste and replace; put back parts, *C* and *D*, leaving the print out. Fig. 3 shows a section of the box at this stage with the seat, *HH*, vacant. The box must be carefully rapped to loosen the core, otherwise it will be broken away at the seat, where it has no protection. The core box is then laid on its side and *A* and *C* are lifted off, which exposes the entire core. A drier is laid over the core, the box turned over, the remaining parts removed, and the core is ready for baking. If made of a fine grade of sand, the core will need no further attention in the way of washes, etc., to produce a smooth casting.

High Pressure Valves and Fittings*

IN the manufacture of modern high duty valves, there are certain rules that must be met in formulating a steam metal. These are: (1) The alloy must resist the wear of steam; (2) it must have sufficient strength; (3) it must be of reasonable cost to manufacture. The latter resolves itself into the question of the alloy lending itself readily to casting and machining. The wear of steam is a simple erosion, a mechanical wearing away, abetted by temperature, and in some instances by chemical corrosion. The ability to resist wear may be measured by the hardness of the metal.

Copper Alloys.

Copper is the basic metal in the non-ferrous steam metal alloys. Measured by our specifications, unalloyed copper falls short on all counts, having neither the wearing quality, the strength nor the low cost of manufacture. The desired hardness is given to copper by adding tin, and scleroscope tests have shown that bronze containing less than 5.5 per cent tin is not sufficiently hard to withstand in a satisfactory manner the wear of ordinary steam pressures. Up to the point where too great hardness is obtained for machining purposes, the percentage of tin and hardness are directly proportionable. Tin increases the cost of the alloy, which cannot be decreased by the substitution of zinc or lead, and the virtue of the alloy preserved. Zinc has a slight hardening effect on copper

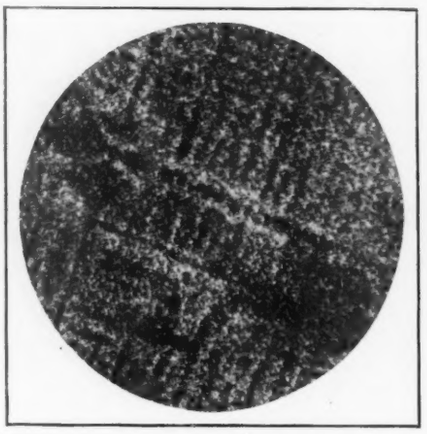


FIG. 1—MICRO-PHOTOGRAPH OF STEAM METAL; COMPOSITION: COPPER 88, TIN 7, ZINC 4 AND LEAD 2; TENSILE STRENGTH, 34,000 POUNDS
(Magnification, 150 diameters)

and over 45 per cent would be necessary to impart the same endurance to wear that 5.5 per cent of tin would give. Zinc cannot be substituted for tin and is permissible only in small amount to insure good castings, and so it may help to reduce the foundry cost.

Lead is allowable only in percentages less than 2 per cent, for the purpose of reducing the cost of finishing or machining. The less the lead, the better the wearing quality and strength of the metal. Over 2 per cent lead is common practice, and in fact, its use in quantities much over that characterizes the cheap valve. I have found as much as 13 per cent lead in some so-called steam metal valves bought in the open market. In excess, lead does not alloy properly, but forms soft lead spots all through the micro-structure of the metal, and this makes "wire drawing" of the seat and disc, by the passing steam, an easy matter.

The micro-photograph, shown in Fig. 1, is of a steam metal with less than 2 per cent of lead, and Fig. 2 shows the same metal with 6 per cent of lead, which is quite recognizable in the dark spots. The strength of the alloy is due largely to the tin. Chemical composition is not the only consideration, as foundry practice has a profound influence. Micro-photographs, Figs. 3 and 4, show the same metal poured when too hot and when too cold. The striking changes observed in the structure are accompanied by equally serious changes in the tensile strength. The condition of the molding sand, time of melting and nature of fuel all have important effects on the physical properties of the alloy.

*From a paper presented by George K. Elliott at the 21st meeting of the Ohio Society of Mechanical and Electrical Engineers.

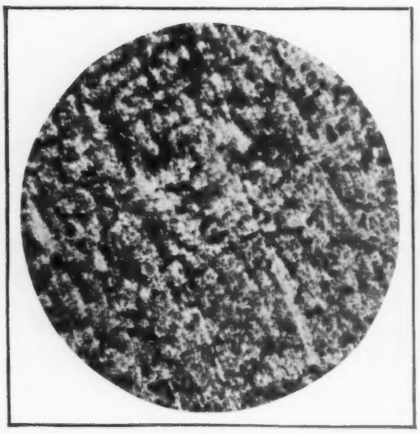


FIG. 2—OVER-LOADED STEAM METAL; COMPOSITION: COPPER 86, TIN 5, ZINC 3 AND LEAD 6; TENSILE STRENGTH, 26,000 POUNDS
(Magnification, 150 diameters)

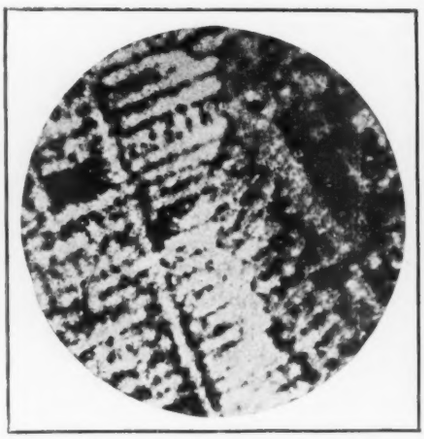


FIG. 3—STEAM METAL, CAST AT TOO HIGH A TEMPERATURE; COMPOSITION: COPPER 88, TIN 7, ZINC 4 AND LEAD 2; TENSILE STRENGTH, 24,500 POUNDS
(Magnification, 150 diameters)

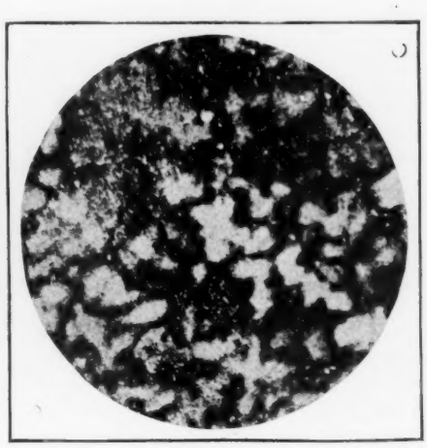


FIG. 4—STEAM METAL, CAST AT TOO LOW A TEMPERATURE; SAME COMPOSITION AS FIG. 3; TENSILE STRENGTH, 22,800 POUNDS
(Magnification, 150 diameters)

Foundrymen's Convention

AT A joint meeting of the executive officers of the various foundrymen's organizations, held at the Fort Pitt hotel, Pittsburg, Tuesday, Oct. 11, preliminary arrangements were made for the next convention, which will be held in that city during the week of May 23, 1911. On Monday, a stockholders' meeting of the recently incorporated Foundry and Machine Exhibition Co., was held, and a permanent organization was effected with the election of the following officers:

George R. Rayner, Carborundum Co., Niagara Falls, N. Y., president; E. H. Morgan, Arcade Mfg. Co., Freeport, Ill., vice president; J. S. McCormick, J. S. McCormick Co., Pittsburg, treasurer; C. E. Hoyt, Lewis Institute, Chicago, secretary. Trustees, three years: Wilfred Lewis, Tabor Mfg. Co., Philadelphia; H. R. Atwater, Osborn Mfg. Co., Cleveland; F. N. Perkins, Arcade Mfg. Co., Freeport, Ill.; two years: E. H. Mumford, Mumford Molding Machine Co., New York City; H. A. Pridmore, Henry E. Pridmore, Chicago; H. T. Frauenheim, Herman Pneumatic Machine Co., Zelienople, Pa.; one year: E. A. Pridmore, Edward A. Pridmore Co., Chicago; J. W. Campbell, Cleveland Wire Spring Co., Cleveland, and R. S. Buch, A. Buch's Sons' Co., Elizabethtown, Pa. Executive committee: F. N. Perkins, chairman; R. S. Buch and H. T. Frauenheim.

Foundry Supply Association.

On Tuesday morning, the annual meeting of the executive committee of the Foundry and Manufacturers' Supply Association was held. This organization was formed at the time of the Cleveland convention to conduct an exhibit of foundry supplies and equipment in the Central armory, and this proved so successful that it was decided to make these shows a feature of the foundrymen's conventions. Exhibitions were subsequently conducted at Philadelphia, Toronto, Cincinnati and Detroit, and at the meeting of the members, held at the latter place, a committee of three was appointed to investigate the feasibility of incorporating. A report was subsequently presented to the executive committee to the effect that since the Detroit convention, a number of molding machine manufacturers had formed the Foundry and Machine Exhibition Co., incorporated under the laws of the state of Pennsylvania, and since its purpose was the same as that of the Foundry and Manufacturers' Supply Association, it was recommended that this company be accepted in lieu of the incorporation of the supply association.

At the Pittsburg meeting the executive committee, therefore, adopted the following resolution, which provided for the dissolution of the Foundry and Manufacturers' Supply Association:

Resolved, that the Foundry and Manufacturers' Supply Association be disbanded and that the treasurer be empowered to remit all funds in his hands to members, pro rata, after defraying the standing liabilities; the foregoing resolution to be submitted to the membership not later than Oct. 20, in writing, the ballot being returnable not later than Oct. 30; the acquiescence of members not returning ballots will be taken for granted.

A committee of three, consisting of S. T. Johnston, S. Obermayer Co., Chicago; R. W. Turnbull, Henry E. Pridmore Co., Chicago, and F. N. Perkins, was appointed to wind up the affairs of the association.

It will be noted that the officers of the Foundry and Machine Exhibition Co., are the same as those elected at the annual meeting of the Foundry and Manufacturers' Supply Association in Detroit.

Convention Plans.

The Pittsburg convention plans are well under way and the indications are that many papers on live foundry topics will be presented. A special committee has been appointed to take charge of this feature of the program. The Associated Foundry Foremen will also hold a rally of all of the foundry foremen and superintendents in attendance, which promises to be one of the most notable events of its kind ever held. The Pittsburg Exposition buildings provide ample space for all of the exhibits and in a large auditorium on the grounds, the professional sessions will be held.

Shot in Cast Iron

THOMAS D. West, 10511 Pasadena avenue, Cleveland, is conducting an investigation to ascertain the cause of globules or shot iron, so frequently found in gas cavities or blow-holes in iron castings. Mr. West desires the co-operation of foundrymen throughout the world who have specimens of this phenomenon. In addition, information from those forwarding such specimens is desired regarding the character of the pig iron, scrap, fuel, and the nature of flux used. An analysis of the iron is also requested. Furthermore, it is recommended that a rough sketch of the casting be forwarded, showing its form and the thickness of the various sections so far as possible, with the location indicated from which the sample has been taken. Mr. West also desires to know whether the mold in which the casting was made was green sand, skin-dried, dry sand or loam, together with details of the manner of gating and pouring. If possible the temperature of the metal should be indicated, although information as to whether it was "hot," "medium" or "dull" will aid materially. Specimens are also desired showing white iron inside of gray or soft iron.

Foundrymen of foreign countries, as well as those of the United States, are invited to aid in this work, and the results of the investigation will be given to the trade through the medium of a paper to be presented before one of the foundry or engineering societies.

Strong Iron

By N. W. Shed

Question:—We would like to obtain an iron that will give a tensile test of approximately 35,000 to 40,000 pounds per square inch. The iron in our yard analyzes as follows: Silicon, 2.49 per cent; sulphur, 0.02 per cent; phosphorus, 0.65 per cent; manganese, 0.78 per cent. Another brand analyzes: Silicon, 1.32 per cent; sulphur, 0.03 per cent; phosphorus, 1.37 per cent; manganese, 0.79 per cent. We also have some malleable iron on hand of the following analysis: Silicon, 1.07 per cent; sulphur, 0.024 per cent; phosphorus, 0.159 per cent; manganese 0.86 per cent.

Answer:—A tensile strength of 35,000 to 40,000 pounds per square inch is asking a good deal of cast iron and it would be almost impossible to make it of coke iron, although the best grades of eastern charcoal iron will probably give this strength. By using steel with the malleable coke iron on hand, this result could be obtained. The mixture would be made up as follows: Malleable pig, 80 per cent; steel scrap, 19 per cent; ferro-manganese, 1 per cent. This would give a close-grained, strong iron, but for thin castings, it might be mottled and the corners of a 1-inch square test bar might be white. In case this mixture is too hard, it would be well to try 10 per cent of the 2.49 silicon pig; 10 per cent of car wheels; 14 per cent of steel scrap; 65 per cent coke malleable pig, and 1 per cent of ferro-manganese. There would be little danger of this mixture running white. The silicon would be about 1 per cent in the casting. This would be the better mixture for 1-inch metal and for 2-inch metal the first mixture is recommended. The best results are obtained by melting in the air furnace. Many of the strong mixtures contain a large percentage of charcoal iron, but this is not necessary if the steel mixture is well melted.

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Trade Outlook

Foundry trade conditions displayed a marked improvement during October, and that the melt is increasing throughout the country is indicated by the growing volume of small orders for pig iron. Large consuming interests are also showing more willingness to entertain propositions for iron to cover future requirements, but immediate consumption is still far below production, notwithstanding the idleness of many blast furnaces. Jobbing shops are more fully engaged than for several months, and steel foundries, specializing in railroad work, report that these interests are placing orders quietly to cover their immediate needs. It is generally conceded, however, that there will be considerable hesitancy on the part of large buyers until the attitude of the Interstate Commerce Commission, concerning freight rates, shall have been determined. Manufacturers of automobile parts are resuming operations and are stocking their product in anticipation of a heavy demand from automobile builders during the winter months. Brass and aluminum foundries, as a result, are more actively engaged and the outlook in this branch of the foundry business is more hopeful. No. 2 foundry iron is quoted in the leading centers, as follows. Local, Chicago, $16.00; southern, Cincinnati, $14.25; northern, Pittsburg, $14.90; southern, Birmingham, $11.50; northern, Cleveland, $14.25; eastern Pennsylvania, Philadelphia, $15.25. Quotations on other grades follow: Lake Superior charcoal, Chicago, $18.00; basic, Pittsburg, $13.90, and malleable Bessemer, delivered at the same point, $14.90.

Standardized Flasks

A plan for standardizing or establishing what may be called a United States standard for foundry flasks, is suggested in the *Metal Worker*, by M. W. Griswold, of New York, who says: "On account of the variations in castings for flasks, all measurements as to list sizes must be made on the inside at the parting line, and the sizes listed at the full half inch found next below the actual measurement. For instance, should the actual width be 12⅝ inches and the length 14 3/16 inches, it must be listed as 12½ x 14. The location of the pinholes are not to be made from the actual measurement of the flask, but from the list size, as illustrated above. The measurements are taken from lines drawn at right angles through the actual center of the flask. The distance between the holes in the sides of the flask must be exactly 3/5 of the list length (or 3/10 from the actual center line), from center to center, and the distance between holes in the width of the flask must be exactly 2¾ inches greater than the list width, or 1⅜ inches more from center line to center of pinholes. For flasks of less than 500 square inches of surface measure, the pinholes must be exactly ½ inch in diameter."

Commenting on the above our contemporary says: "It is somewhat strange, in view of America's unchallenged leadership in the development of interchangeable systems, that the flasks of one foundry are not interchangeable with those of another for castings of substantially the same size. It is perhaps not so much the size of the flasks that is the cause of the trouble, as it is the location of the flask pins. It is of course recognized that a small fraction of an inch leeway makes it impossible in many cases for a cope from one foundry to fit the drag of another without running the risk of castings showing too prominently the line of parting. It will be noted that it is stipulated that list sizes of flasks are to be made from internal measurements. It will thus be seen that one having to make castings of a certain size can determine at the outset what list size flask is suitable for the work. It is important to note that the location of the flask pins will be identical with all flasks of the same list size, and incidentally it may be stated that Mr. Griswold finds that these dimensions show a very close agreement to many of the flasks now in use."

We may be permitted to doubt, however, whether foundrymen will feel greatly interested in this suggestion, there being no apparent necessity for such a standardization, as it is a rare occurrence for foundries to borrow parts of large flasks from each other. With the small sizes, as mentioned by Mr. Griswold, considerable standardization has already been accomplished, due to the use of the molding machine, and this will undoubtedly continue, as standard, interchangeable flasks are inseparately connected with the successful operation of these machines. With regard to jobbing foundries, brass founders are the most extensive users of iron flasks, most of which are purchased from concerns that specialize in their manufacture and have established their own standards,

which have been in use for years, and to which they adhere. Therefore, flasks purchased 10 years ago will match with new ones of today, the only precaution necessary being to obtain them from the same maker. Different makes of flasks do not interchange, as the pins are differently located, some being carried on lugs attached to the sides of the flasks, others are on the corners, and some are in the center of either end. Each style has something to recommend it, and has its adherents who would not change to any other method of locating pins from that to which they have become accustomed. The sizes, however, are largely standardized so that it is seldom that a pattern gated for the convenience of one jobbing foundry cannot be used in another, and this, it seems to us, is about as far as standardization need be carried.

Cylinder Mixtures

To the Editor:

In the October issue of THE FOUNDRY, page 82, Henry Souther criticizes the cylinder mixture, recommended in the September number. Mr. Souther seems to be under the impression that the cylinder referred to was for automobile use, but the question asked for information regarding an iron "which will have the least tendency to draw where the heavy and light parts join," and does not refer to automobile cylinders. The actual case I had in mind was a large gas engine cylinder, more than 2 inches thick in the main part and surrounding this was a water jacket, about ½ inch in thickness. Where the thick and thin parts joined, there was always a draw when the cylinder was made according to Mr. Souther's suggestion. When the mixture, which I recommended, was used, all tendency to draw disappeared. Since that time at least 20 cylinders have been made without experiencing any trouble from checking. If this cylinder had been designed with a more uniform section, Mr. Souther's composition would have been preferable, and in heavy cylinders of uniform section I would suggest reducing the silicon much lower than he does, making it 1.20 to 1.30 per cent if possible. Mr. Souther's composition for automobile cylinders may prove very satisfactory, but it would hardly answer for large gas engine cylinders of heavy and light section.

N. W. SHED.

Purchasing Steel Castings

To the Editor:

In an article entitled, "The Business Man in a Steel Foundry," by John Gebhard, published in the October issue of THE FOUNDRY, it was stated that it is the general practice, when bidding on work, to set one price for both heavy and light, so that the loss on the complicated castings must be offset by the profits on the heavier sections. I am now handling two steel casting accounts and in each case the schedule of price runs about as follows:

1	to	5	pounds.
11	to	25	pounds.
26	to	50	pounds.
51	to	75	pounds.
76	to	100	pounds.
101	to	250	pounds.
251	to	500	pounds.
501	to	750	pounds.
751	to	1000	pounds.

Special prices are named on all castings weighing over 1,000 pounds. The writer was formerly superintendent of a large steel casting plant and at no time were castings sold on a flat basis, except when quotations were made on car work. All steel foundries specializing in this line, quote a flat price, but as this line of work is the exception rather than the rule, it should not be confounded with the general class of steel castings. I merely desire to call attention to this, as I believe this article might mislead prospective purchasers of steel castings.

THOS. F. MEEK.

Personal

Louis Waggoner, formerly with the American Foundry Co., Indianapolis, has taken charge of the core department of the new foundry built by the M. Rumely Co., La Porte, Ind.

J. F. Gaffney, formerly connected with the S. Obermayer Co., Cincinnati, is now associated with the Keystone Foundry Supply Co., manufacturer of foundry facings and supplies, Buffalo.

John J. Buckley has resigned as president of the Keystone Steel Casting Co., Chester, Pa.: Daniel Egan, as vice president and general manager, and Patrick Connors, as foreman of the foundry.

W. R. Dean, who recently resigned his position as foreman of the Lumen Bearing Co., Buffalo, has accepted a similar position with Peck Bros. & Co., New Haven, Conn., manufacturers of plumbers' brass goods.

John H. Robinson has closed his aluminum foundry, which he recently started in Bridgeport, Conn., and is now representing the Jonathan Bartley Crucible Co., Trenton, N. J., in New England, acting in the capacity of eastern traveling representative.

Lewis D. Bertzel, formerly foreman of the brass foundry of the Watertown Arsenal and later connected with the Crescent Park Brass Foundry, Waltham, Mass., has returned from the Philippine Islands, where he has been for some time in the employ of the government foundries.

Geo. H. Foley has resigned as foundry foreman of the Brown Cotton Gin Co., New London, Conn., to accept a position of superintendent of the Rice, Barton & Fales Machine & Iron Co., Worcester, Mass. Mr. Foley was presented with a gold watch by the employes of the shop.

P. T. Laws has been appointed manager of the United States Cast Iron Pipe & Foundry Co.'s plant at Anniston, Ala., succeeding Acting Manager E. P. Koetter, who has returned to the general offices of the company at Louisville. Mr. Laws is an experienced cast iron pipe manufacturer and succeeds W. D. Roos, who was promoted to the position of general inspector.

E. Stutz, vice president and general manager of the Goldschmidt Thermit Co., 90 West street, New York City, has retired and this concern is now under the management of William C. Cuntz. Mr. Cuntz has a thorough knowledge of the steel business and a wide acquaintance with the railway and street railway officials of the country, having been connected for 18 years with the Pennsylvania Steel Co.

Thos. F. Meek, formerly superintendent and manager of sales of the Detroit Steel Casting Co., Detroit, has organized the firm of Thos. F. Meek & Co., manufacturers' sales agents, with offices in the Moffat building, Detroit. This concern represents the Standard Sand & Machine Co., Cleveland, as well as Wm. McClellan & Co., Bettcher Mfg. Co., Fred C. Acker Co., Strong Steel Foundry Co. and the Chicago Foundry Co.

H. J. McCaslin, foreman of the pattern shop of the Wellman-Seaver-Morgan Co., Cleveland, during the past 10 years, has resigned to assume his duties as instructor in patternmaking at the Technical High School, Cleveland, to which position he was recently appointed. Mr. McCaslin is well fitted for this advanced work, having had not only a wide experience in practical patternmaking, but is conversant with the operation of both iron and steel foundries.

Book Reviews

Practical Alloying, by John F. Buchanan; 6 x 9 inches, 41 illustrations, 205 pages, published by the Penton Publishing Co., Cleveland, and furnished by THE FOUNDRY, carriage prepaid, for $2.50.

This latest contribution to the meager literature on brass foundry practice, is from the pen of a writer of wide practical experience, who has contributed freely to trade publications, and is favorably known as the author of "Brass Founders' Alloys" and "Foundry Nomenclature." Considerable matter contained in this work originally appeared in THE FOUNDRY and other technical magazines, and having been revised, rewritten and added to, now appears in more convenient book form.

The first chapter, "Metal Refining, Ancient and Modern," treats of the antiquity of copper and bronze, the work of the alchemists, and the treatment of ores and their electrical reduction. This is followed by a chapter on the "History and Peculiarities of Alloys," in which is outlined the importance of bronze in the affairs of the world. It also treats of the origin of gun metals and gives definition of bronzes and alloys. The third chapter deals with the properties of alloys and their classification, and discusses their relative hardness, density and working properties. Tables are also included, giving the relative conductivity of metals and the remarkable effects produced by slight variations in the casting temperature of typical alloys. The oxidation of metals is also considered, as well as the physical characteristics of alloys, grading by fracture, etc. Pertinent points on alloying are also given, as well as suggestions on the use of aluminum as a flux, the disparity in the melting points of metals, brass foundry ratios, etc.

Other chapters discuss the color and notation of alloys, and contain formulae for making Delta metal, red and yellow brasses, brazing metals, modern bronze alloys, with a discussion of their peculiarities and practical suggestions for alloying phosphor bronze, gun metals, anti-acid metals, aluminum and its alloys, such as Susini's alloys, nickel aluminum, magnalium, etc. Tables for formulae are also given for making aluminum bronze and brass, manganese-bronze, babbitt and anti-friction metals of all kinds, with a comprehensive discussion of their qualities, peculiarities and methods of alloying. Alloy formulae are also continued in chapter IX, under the title of "Foundry Mixtures," which tell how to make the standard alloys and how to use and proportion scrap metals in red brass, steam metal, gun metal, bell metal, etc. Mixtures are also given for dipping metals for chandelier work, nickel bronze and all classes of alloys used in shipbuilding. The chapter also treats of dips and lacquers, and contains pickling solution for removing sand from brass castings and formulae for bronzing solutions and bright dips.

Chapter X is devoted largely to pattern alloys and discusses the suitability of various alloys for this purpose, including the white metals and aluminum. Solders and novelty metals of all kinds are discussed and formulae given in chapter XI, and fluxes for alloys follow in the succeeding chapter, which contains lists of every available substance or chemical used for this purpose. It also treats of the manner in which they are used and their influence on the metal. Other chapters treat of gates and risers, testing alloys, with tables of contraction, specific gravity, ductility and other properties. A chapter is also devoted to crucibles and how they should be cared for to prolong their period of usefulness.

The book is written in an entertaining style that makes it a literary production of marked worth, as well as a practical and valuable treatise on the art of brass founding.

General Foundry Practice, by William Roxburgh; 8½ x 5½ inches, 296 illustrations. Furnished by THE FOUNDRY for $3.50.

The author of this work is a well-known contributor to British foundry trade journals and is an experienced molder and foundry manager. The book is divided into three divisions, with several additional chapters treating of metallurgy, patternmaking, etc. The first division, entitled "General Iron Founding," contains 26 chapters. The first chapter, which treats of starting a small iron foundry, gives some excellent advice on this subject. Other chapters treat of sands, facings, blowholes and shrinkage troubles, venting, chaplets, the use of risers, mixing of metal and the molding of pipes, cylinders and other castings, in both dry and green sand, and contains much practical information. The second division is entitled, "Jobbing Loam Practice," and describes the tools and methods used in the loam molding of cylinders, pistons, etc., and the use of ashes and dry sand in connection therewith. The third division is devoted to the casting of brass, aluminum and the non-ferrous metals generally. It is entitled, "Molding and Casting the Finer Metals," and the first chapter advises how to start a small brass foundry, illustrates and describes the British type of square, brick brass melting furnaces, and also discusses waste in melting, temperatures, draw and integral shrinkage, position of casting and cooling the castings. A chapter on "Bronzes," treats of aluminum, phosphor, and manganese bronzes, methods of casting them, etc. The chapter devoted to casting speculums describes the methods found best in making this difficult class of castings, also the manner in which they are annealed.

The work treats of the fundamental principles of founding as exemplified by British practice, and contains many valuable suggestions that will make it a welcome acquisition to foundry literature. It is, however, tinged with a strong conservatism, inclining at times to prejudice, which detracts from the value of the book to the progressive foundryman. The practice in which the foundry has progressed the most is discussed in a manner that almost places the stamp of antiquity upon what otherwise might have been considered interesting and useful. It would have been better if the chapters on molding machines and sandless castings had been omitted, as in view of recent progress along these lines it cannot truthfully be stated that the former are "circumscribed in scope and practice," and "that it is doubtful if the output of machines is greater than is accomplished by hand." In the case of sandless castings, the author appears to be ignorant of recent developments in making castings in permanent molds, or he would not state, "that with a foundry of iron molds we only require a place to melt metal, conditions for molding that are too rosy to be real," and gives it as his opinion that, "with sandless or iron mold casting, nothing but a sash weight or castings of similar design are possible and that a contrary opinion shows a want, or at least a limited knowledge of the laws of expansion and contraction, and the wonder is how there can be two opinions on this question of foundry practice."

The Falls Rivet & Machine Co., operating plants at Cuyahoga Falls and Kent, O., announces that Edwin Seedhouse and associates have purchased the plant and rivet, bolt, nut and washer business, carried on at Kent by this concern, and will operate the same under the corporate name of the Falls Rivet & Machine Co. Theophilus King and associates have succeeded to the plant, power transmission and general machinery business of the Falls Rivet & Machine Co., Cuyahoga Falls, and the same will hereafter be conducted under the firm name of Falls Clutch & Machinery Co.

FOUNDRY and PATTERN SHOP EQUIPMENT

Foundry grab bucket --- Coremaking machine --- Portable, pneumatic power-ramming molding machine --- Cabbaging press --- No-shock jolt-ramming molding machine --- Portable furnace --- Ventilator

Foundrymen have long felt the need of a grab bucket, suitable for handling sand and for cleaning up the floor, which could be operated by the regular foundry crane, without the necessity for investing in special hoisting apparatus. After considerable experimenting, the Pawling & Harnischfeger Co., Milwaukee, has produced a bucket along these lines which has proven entirely practical and satisfactory in everyday foundry service.

One of the features of this bucket is, that in operation it is merely picked up by the hook of any ordinary traveling crane, no special hoisting apparatus being necessary. It is manipulated entirely by the crane and the single tripping line, and may be hooked onto or off in an instant, leaving the crane free for other work.

Fig. 1 shows the bucket lowered, ready to pick up its load. The bucket is carried on two wire ropes which are deadened in an equalizer fixed to the framework. From their point of fastening, the ropes lead downward around the pulleys in the tackle block and then up again, terminating in a heavy cast steel bail or yoke which is placed over the crane hook.

When the crane hook is raised, with the bucket in the position shown in Fig. 1, the jaws of the bucket close, picking up the load. By means of a linkwork the tackle block moves up in a straight line. As the bucket is lifted, it assumes the position shown in Fig. 2. In this position it may, with its load, be raised or lowered, or carried to any point reached by the crane.

To drop the load, the tripping line attached to the tripping lever is pulled, thus disengaging a hook which connects the main bucket pivot to the tackle block. This allows the pivot center to descend and the bucket to open into the position shown in Fig. 3, discharging the load. In this position the bucket may be carried about, raised or lowered by simply manipulating the crane.

When lowered to the ground, as soon as the jaws strike, the stress on the tackle block is relieved and, since the crane hook continues to descend, the tackle block descends in an arc until the hook on the under side of the tackle block again catches the main pivot center, restoring the mechanism to the position shown in Fig. 1. The heavy chains, shown in Figs. 1 and 3, limit the opening of the bucket leaves or jaws and are connected at the top to spiral springs which absorb the slight shock incidental to the opening of the bucket.

The bucket is designed as a scraping tool, rather than as an excavator, and is used entirely to handle sand to and from the bins or pile, and is being employed in foundries for leveling off and cleaning up the floors after the flasks are shaken out. In this service, in a large steel foundry, one bucket supplanted six men employed as sand shovelers. This gives some idea of the labor saving possibilities of the device.

The capacity of the bucket is 1½ cubic yards; loaded with sand it weighs four net tons and empty, about two tons. The bucket may be handled by any crane of sufficient capacity. The floor space covered, when the bucket is spread open, is 6 x 6 feet, the bucket being made wide to cover as large an area as possible. The bucket will work in a headroom considerably smaller than that usually required by the ordinary type of grab bucket, and is durable in every point of construction.

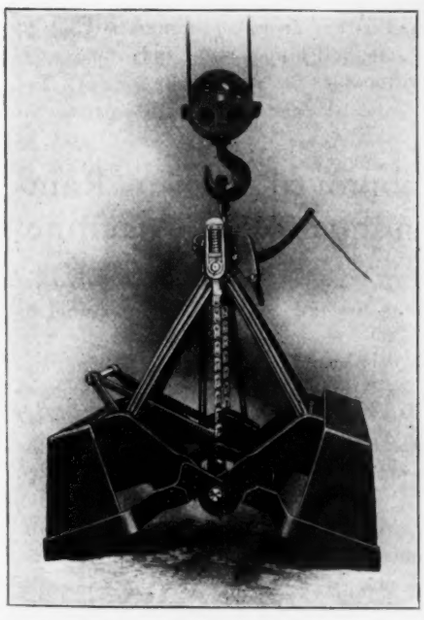


FIG. 1—GRAB BUCKET READY TO TAKE UP LOAD

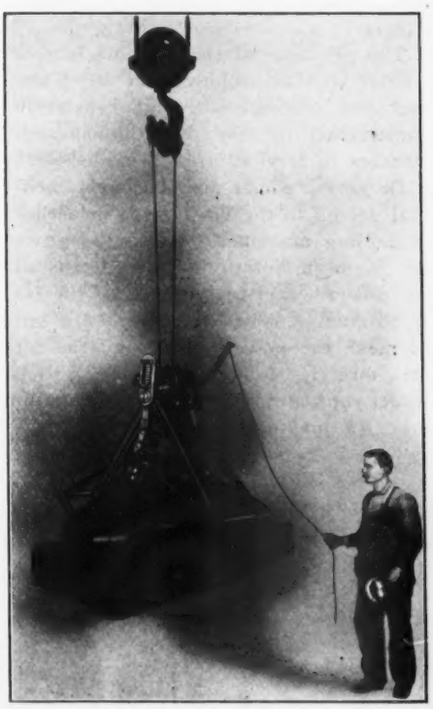


FIG. 2—GRAB BUCKET CLOSED WITH LOAD

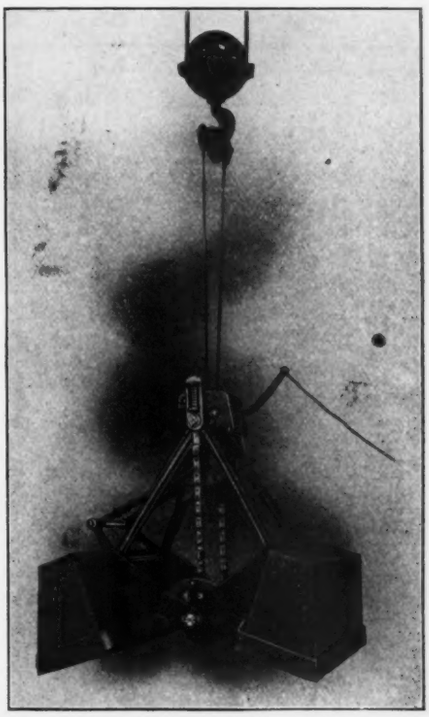


FIG. 3—GRAB BUCKET IN DISCHARGING POSITION

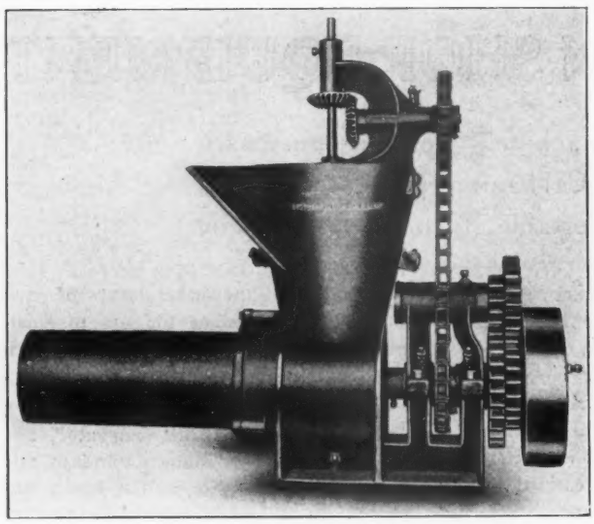


FIG. 1—COREMAKING MACHINE, DESIGNED TO MAKE CORES UP TO 11 INCHES IN DIAMETER

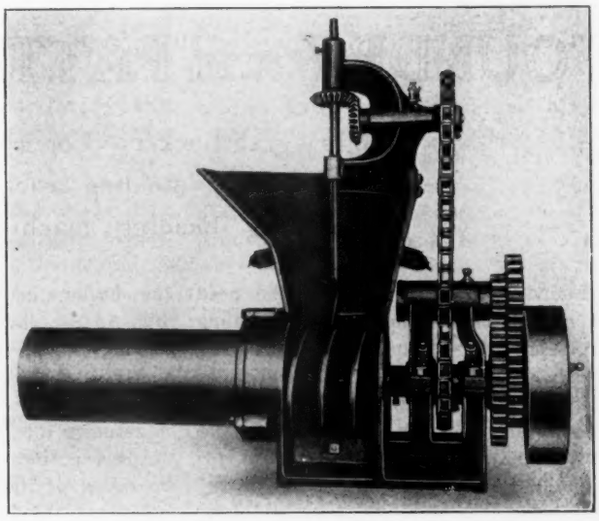


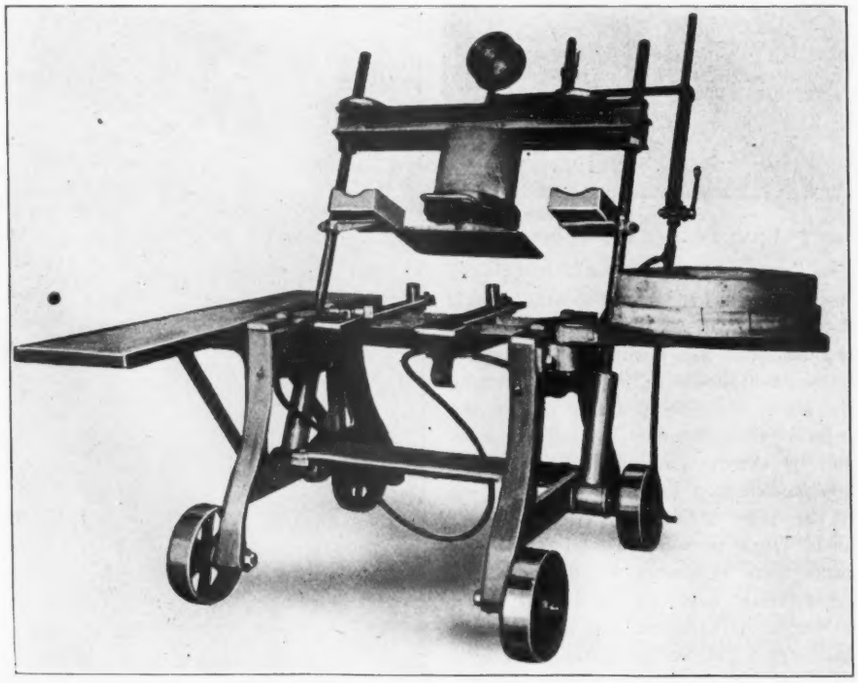
FIG. 2—COREMAKING MACHINE, SHOWING SECTIONAL VIEW OF HOPPER

Coremaking Machine

The Brown Specialty-Machinery Co., Chicago, manufacturer of core machines, has recently perfected a machine designed to make round cores up to 11 inches in diameter. Heretofore the largest round cores made on the Hammer machine were 3 inches in diameter. The new machine, illustrated herewith, will produce round cores from ⅜ to 7 inches in diameter, inclusive, and rectangular cores from ⅜ to 5 inches on a side. With special dies which can be fitted to the machine, round cores can be made up to and including 11 inches in diameter and square cores up to 7½ inches square.

The principle of the new machine is similar to that employed in the Hammer core machine, although heavier in construction to take care of increased stresses in service. It is provided with back gears, which are similar in general design to the back gears on lathes or milling machines. When the gears are in mesh a ratio of three turns of the power wheel to one turn of the bit is obtained. When the gears are out of mesh the power wheel and the bit are directly connected. The pulley wheel runs at 150 revolutions per minute. In making cores up to and including 3 inches in diameter, the back gears are not used, but are thrown into mesh for cores between 3¼ and 11 inches in diameter. The chain, bevel gearing and vertical force feed on the new machine are considerably heavier than on the older type and the conveyor is also extra heavy and is made of tool steel.

The sand hopper of the enlarged machine is provided with a lip which increases its capacity and makes it easy to feed. The core mixture used in the new machine is the same as that formerly adopted for the Hammer machines, namely 100 parts core sand, 12 parts flour and 1 part linseed oil, thoroughly mixed and sifted. The proportions of this mixture can, of course, be varied considerably, depending on the type of cores which are to be made. This machine is provided with a belt pulley and may be operated either from a countershaft or by a one-half-horsepower, individual electric motor.



IMPROVED PORTABLE, PNEMATIC, POWER RAMMING MOLDING MACHINE

Improved Power Ramming Molding Machine

The portable, pneumatic, power-ramming molding machine, manufactured by the J. F. Webb Mfg. & Supply Co., Davenport, Ia., as redesigned and improved, is shown in the accompanying illustration. This machine is adapted for all classes of snap flask work, the ramming of the sand being accomplished by compressed air. The table of the improved machine is larger than the table of the former type, while the head swings in a greater arc, clearing the table so as not to interfere with the operator in closing the flask. A swinging riddle rack has also been attached,

which is shown at the right in the accompanying illustration. The riddle on this rack can be moved forward within easy reach of the operator when riddling sand onto the pattern and when not in use can be swung back so as not to interfere with the operator. The side shelf at the left has also been enlarged. This machine is built in two sizes for flasks 10 x 30 inches and 12 x 36 inches. The J. S. McCormick Co., Pittsburg, is exclusive selling agent.

Cabbaging Press

One of the difficulties experienced by the brass melter is to introduce into the crucible, in one charge, a sufficient amount of scrap and cold metal to make a heat of average weight. The scrap comes to the furnace in all shapes and sizes. The usual method of treating the scrap is to cut or break it into pieces of convenient size and then to pound it into a pot or half-keg, making a ball approximately the shape of the crucible. This cabbaging process is slow, laborious and expensive.

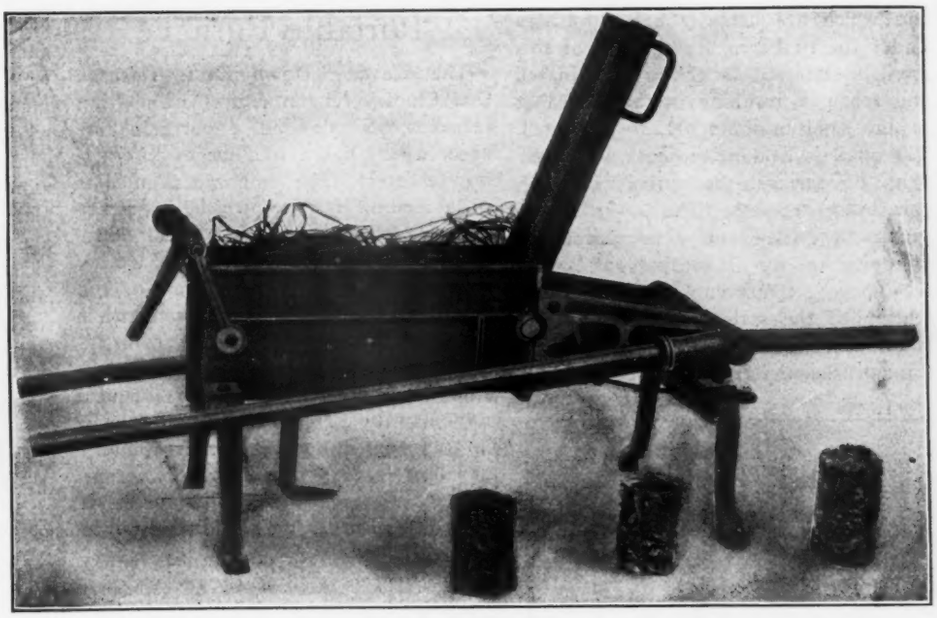
The Famous Mfg. Co., East Chicago, Ind., has recently designed and perfected a hand power packing press which reduces the scrap to the proper shape for charging into the crucible and obviates many of the difficulties and unsatisfactory results connected with cabbaging by hand.

The machine compresses either brass or steel scrap into compact, cylindrical shapes which fit snugly into the crucible. The packer is operated by hand but may be arranged for power operation if desired.

In using the packer, the top is raised, the rammer is drawn back and the cylindrical pressing trough is filled with scrap, as shown in the accompanying illustration. After being filled, the cover of the machine is slammed down hard and closed tight by means of the roller cam connected to the self-locking lever attached to the left end of the pressing cylinder.

The scrap is now confined in a cylinder, in one end of which is fitted a plunger or rammer. The rammer is connected through cranks and toggles to a cross shaft which is rotated by the long hand levers shown. Raising the hand levers causes the rammer to enter the pressing cylinder and compress the scrap into a compact mass. After being compressed, the roll of scrap is ejected from the machine by means of a foot lever.

The packer is made in two sizes, one producing charges 6 inches in diameter suitable for crucibles Nos. 30 to 50 and the other producing charges 8 inches in diameter suitable for crucibles Nos. 60 to 100. The capacity of the packer is from two to four tons per day, depending on the skill of the operator and the nature of the scrap.

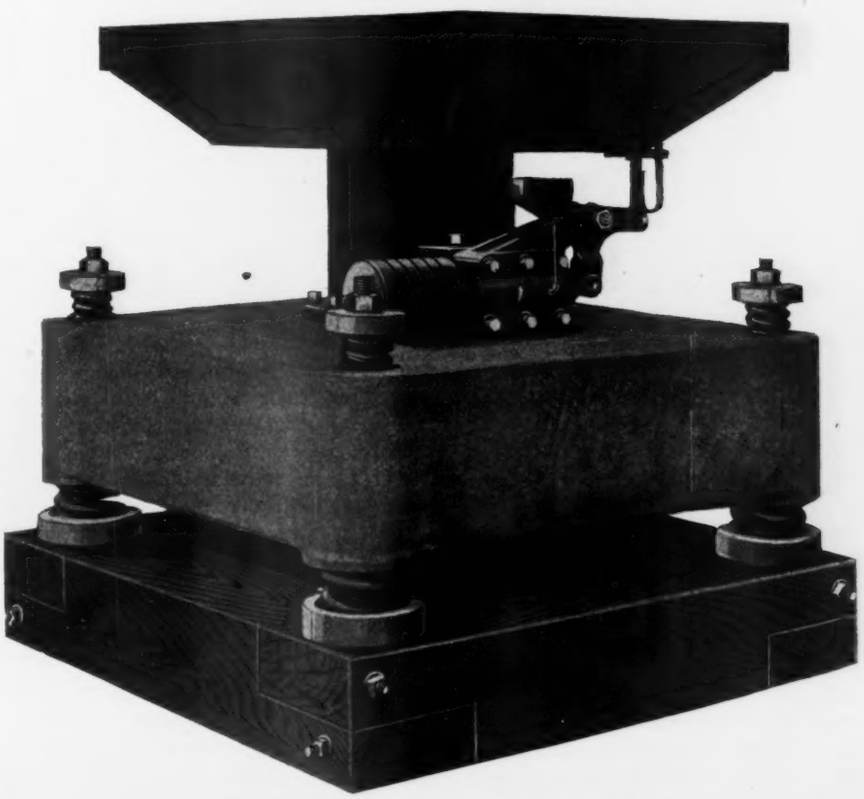


CABBAGING PRESS

H. E. Weidemann, consulting and analytical chemist, 721 Holland building, St. Louis, is sending to the trade a card containing a table for converting long tons into pounds.

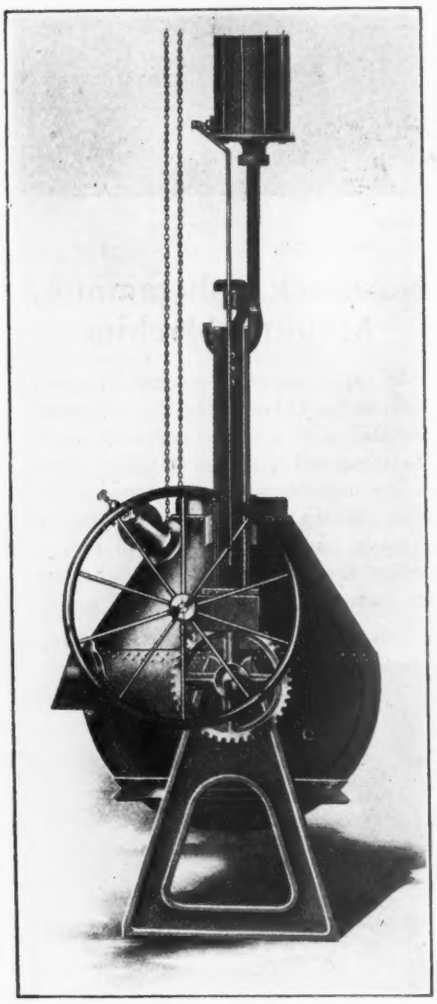
No-shock, Jolt-ramming Molding Machine

A jolt-ramming molding machine, built by the Osborn Mfg. Co., Cleveland, provided with a heavy, cast iron, shock-absorbing bed plate or anvil, is shown in the accompanying illustration. This anvil obviates the necessity of installing a heavy foundation, other than the embedded timbers through which the bolts are passed for the anvils and springs,



NO-SHOCK, JOLT-RAMMING MOLDING MACHINE

and which are held by heavy washers under the timbers. By the use of this anvil, foundation shocks are eliminated and rebound, resulting in the loosening of the sand in the mold, is prevented. The anvil is held in suspension by four pairs of springs, the springs of each pair being separate. The lower set of springs prevents any transmission of vibration to the foundry floor, while the upper set prevents rebound. The tension of the springs is easily adjustable by the nuts on the bolts passing through the timbers. The cylinder of



SIDE VIEW OF PORTABLE FURNACE, SHOWING ARRANGEMENT OF GEARING

the machine is bolted to the bed plate or anvil and the molding machine is shipped intact for installation in the foundry floor. In recent tests of a 12-inch cylinder machine, a 10,500-pound mold was jolted without perceptible jar to the foundry floor and immediately after ramming the mold, one weighing 500 pounds was jolt-rammed without changing the stroke and no foundation shocks could be detected. The anvil of the machine shown in the accompanying illustration weighs six tons.

Portable Furnace

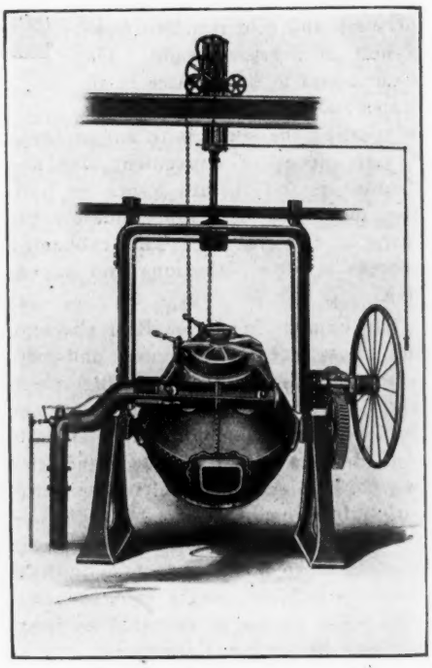
The Hawley Down Draft Furnace Co., Chicago, manufacturer of melting furnaces, has devised a portable furnace, which has a number of interesting features. The equipment consists of a melting furnace, which, by means of a frame built of heavy steel channels is swung on an I-beam trolley fastened to the ceiling or wall of the foundry. By means of a pneumatic hoist the furnace is lifted from its trunnions and may be carried to any desired part of the shop. The furnace may also be arranged so that it can be transported by the regular foundry traveling crane, providing the crane capacity is sufficient. The metal is poured from the furnace directly into the molds.

The furnace is tilted by means of a specially devised set of gears, so that the actual pouring is done with much greater facility than can be done with a ladle by hand. The fact that the metal is not transferred into ladles does not necessitate its being so hot as under former conditions. For instance, if the metal must be poured from a ladle at a temperature of 2,200 degrees Fahr., it is necessary to heat it to 2,400 degrees Fahr. in the furnace before pouring. The 200 degrees thus saved by doing away with the ladle simply means that the metal is not brought to the higher temperature and effects a saving of time and fuel, as well as unnecessary loss by oxidation. The saving in heat for a temperature difference of 200 degrees amounts to 64,000 British thermal units per ton.

The Hawley company has just equipped the entire plant of the Travileries & Laminoirs of Havre, France, which is one of the largest foundries of its kind in Europe, with these portable furnaces. In this particular plant, a series of air hoists, one attached to each furnace, has reduced the time of making castings fully 30 per cent. During the time when the metal is being melted the furnace rests upon two supports, such as are used with the usual stationary furnace, so that when desired, the portable furnace may be used as a stationary furnace without any change in construction and the hoist may be used for some other purpose in the foundry.

Edward A. Pridmore Co.

The Edward A. Pridmore Co., Chicago, recently incorporated, has established a plant at 2300-2318 South Western avenue, for the manufacture of a complete line of molding machines to meet all foundry requirements. The organizers of this concern have all had a wide experience in the manufacture of molding machines. Edward A. Pridmore, who has been elected president, is the eldest son of the late Henry E. Pridmore, and was superintendent of his plant for several years prior to, and for a time after his death. W. W. Miller, vice president, was associated with the late Henry E. Pridmore since 1899 and worked under Mr. Pridmore's personal supervision for a period of about nine years in designing molding machines that were placed on the market during that period. Mr. Miller is also well known in the foundry trade throughout the central west, where he was special sales representative for several years.



FRONT VIEW OF PORTABLE FURNACE, SHOWING TROLLEY

D. C. Snow, secretary and treasurer of the Edward A. Pridmore Co., was associated with the late Henry E. Pridmore for about nine years and had entire charge of the correspondence, sales and advertising departments.

Foundry Exhibit

An exhibit of foundry supplies and equipment was held at the plant of the S. Obermayer Co., Chicago, on Wednesday, Oct. 26. Large show rooms have been fitted up for the display of supplies and equipment used by foundrymen, and in addition the company's plant was shown in operation and the method of manufacturing plumbago, sea coal facing, core compounds, etc., was explained to the

large number of visitors. Snap and iron flasks, stripper frames, riddles, bellows, core ovens, sprue cutters, etc., are also manufactured at these works. One entire floor was devoted to a working exhibit of core ovens, tumbling barrels, magnetic separators, core machines, etc. The S. Obermayer Co. was represented by S. T. Johnston, O. C. Olson, C. M. Barker, J. E. Evans, Fred J. Brunner, J. Thorner, J. J. McDevitt, O. L. Peterson and F. D. Dodge.

Swartwout Ventilator

The question of how to obtain adequate ventilation at the least cost is quite a problem in many factories, especially as expensive apparatus usually entails a high maintenance cost. The ventilator, illustrated herewith, manufactured by the Ohio Blower Co., Cleveland, it is claimed, affords an

SWARTWOUT VENTILATOR

economical solution of this problem. It is suspended on a tripod, which moves on ball bearings, and is so sensitive that practically the entire ventilator moves with the slightest variation of the wind; therefore, any movement of air across the top induces a flow of air or steam from below, the flow in the air shaft being entirely unobstructed. When open, the four dampers, or louvres, offer a large area for the escape of the air, which in this type of ventilator makes but one turn. The maximum area for discharge is always effective because the wind blows away from, and never into the openings. The four dampers, hinged to the same rod, close simultaneously by gravity, and are opened by pulling a chain. When closed, the louvres shut so tightly, that the entire ventilator becomes both storm and dust-proof, completely protecting the few moving parts. This construction permits of the substitution of a glass top for the usual metal top. The glass is made tight with waterproof cement, making a combined ventilator and skylight which does not exclude the light when the louvres are closed, or partially closed in stormy weather. To obtain the greatest durability, this ventilator is made of a rust-resisting metal which tests have shown to be much superior to the ordinary forms of charcoal iron, galvanized sheets, etc., for exposed sheet metal work.

Correction

In the article describing the power-ramming, roll-over, core molding machine, manufactured by the Elmira Foundry Co., Elmira, N. Y., published in THE FOUNDRY, October, 1910, page 84, it was erroneously stated that both halves of the core are pasted by the special pasting device manufactured by this concern. The paste is applied to the top half of the core only, which is placed over the bottom half, to which no paste has been applied.

Oil-coated Molds

By N. W. Shed

Question:—If blacking, or any kind of oil, is placed on a green sand mold before casting, is the mold better able to resist the action of the metal? What chemical reaction takes place when the molten iron comes into contact with the oil-saturated mold?

Answer:—If blacking is placed on a green sand mold, it protects the sand from the action of the metal. The coating of graphite is practically infusible and is, furthermore, much smoother than the sand surface. This prevents the metal from cutting into the sand, which does not adhere to the casting, and a much better surface is produced. If oil is placed on sand, it affords very little protection, unless some drying oil, such as linseed, is used. Kerosene is frequently applied to green sand molds and is preferred to moistening again with water. If kerosene is used, it burns off quickly and has somewhat the same effect as a small amount of sea coal in the facing, having a tendency to open the sand when it burns and gives a better vent. For large molds, some of the heavier oils can be used. These oils are used, not so much to prevent the sand from being cut, as to insure the sand being in good condition when the metal strikes it. It also effectually prevents a "blow," which might be caused by excessive moisture in the sand when it comes in contact with the hot metal. The only reaction taking place when the metal comes into contact with the oil is that of imperfect combustion. Insufficient oxygen is furnished the oil and a flame is produced that is full of carbon.

Gases in Steel Castings

AN INVESTIGATION into the gases occluded in steel, conducted by Thomas Baker, shows that cast steel, when electrically-heated in a closed porcelain tube, evolves gases of which hydrogen and carbon monoxide form the major portion. An actual analysis of the gases given off from a piece of steel, free from blow-holes, when heated for 36 hours at a temperature of 1,000 degrees Cent., follows: Carbon dioxide, 0.48 per cent; carbon monoxide, 48.05 per cent; methane or marsh gas, 0.40 per cent; nitrogen, 1.45 per cent; hydrogen, 49.62 per cent. The small amount of nitrogen present is rather unexpected, but repeated tests on the steels experimented with have resulted in showing no increase of this percentage. The experiments on sound steel showed that hydrogen was given off at as low a temperature as 300 degrees Cent. This gas comprises over 90 per cent of the total gas emitted up to 500 degrees Cent., at which point carbon monoxide begins to be given off. The total volume of gas emitted amounted to 91.86 cubic centimeter, equal to 10.4 times the volume of the steel. The influence of aluminum in preventing blow-holes seems to be due to the fact that it prevents the liberation of gas during the period of solidification, and not to any action it may have in retarding the production of carbon monoxide.

Trade Notes

The Gobeille Pattern Co., Niagara Falls, N. Y., is sending to the trade a post card folder, which contains a sketch of the growth of this concern written in Mr. Gobeille's characteristic style.

Walter Macleod & Co., Cincinnati, recently secured oil furnace contracts from the J. Baum Safe Co., Cincinnati, Southern Motor Works, Nashville, Tenn., and W. H. Clore Mfg. Co., Washington, Ind.

The American Steel Foundries Co. has equipped its plant at Indiana Harbor, Ind., with several large Schwartz melting furnaces, built by the Hawley Down Draft Furnace Co., Chicago. These furnaces are for special analysis steel.

The foundry of Trefeleres et Laminoirs, Havre, France, one of the largest plants of its kind in Europe, has purchased considerable American equipment. Included in the equipment are a number of new portable melting furnaces designed by the Hawley Down

Draft Furnace Co., Chicago. This concern has also furnished stationary melting furnaces for the iron foundry of Andrea Zuiroga, Manila, Philippine Islands, and also to the naval station at Cavite, Philippine Islands.

The Milwaukee Correspondence Schools, Goldsmith building, Milwaukee, in an eight-page booklet, recently issued, gives pertinent suggestions to young foundrymen for acquiring a knowledge of chemistry, so as to become more successful at their chosen calling.

The Federal Foundry Supply Co., Cleveland, is placing on the market a new core binder known under the trade name of "Federal 3 Star" core oil. It is claimed that it has a greater binding power than pure linseed oil. "Bull Run" talc is another specialty which this concern is offering the trade as a substitute for plumbago.

The new plant of the Metals Welding Co., 4400 Perkins avenue, Cleveland, has been placed in operation. This concern manufactures oxy-acetylene welding plants, and is also engaged in the welding and brazing of all metals, such as cast iron, steel, copper, aluminum and brass. Howard H. Snyder, formerly part owner and chief welder of the Braze-Weld Co., Cleveland, is superintendent of this plant.

The Northern Engineering Works, crane builders, Detroit, are completing an addition to their crane erecting shop, 160 x 60 feet, of steel and brick construction. Three cranes and two overhead trolley runs will serve the floor, electric and pneumatic hoists being used. A new storage yard for structural steel has also been laid out and is served by a 60-foot span, three-motor electric gantry crane. This concern reports the greatest demand for its line of cranes and other products in its history.

The Northern Engineering Works, Detroit, has installed the entire equipment in the new foundry of the Power Specialty Co., Dansville, N. Y. This consists of two cranes and a Newten cupola. In connection with the new addition to the plant of the Kewanee Boiler Co., Kewanee, Ill., the Northern Engineering Works is installing four electric traveling cranes, ranging in capacity from 5 to 15 tons and having 55-foot spans. A Newten cupola has also been installed in the foundry of Little Bros., Port Huron, Mich.

The Detroit Foundry Supply Co., Detroit, manufacturer of foundry supplies and equipment, has established a western branch in the Minnesota Transfer, St. Paul, with Wm. H. Case as manager. A complete line of foundry supplies will be carried in stock, such as facings, fire brick, etc., as well as electro-plating supplies, including buffing compositions, polishing wheels, chemicals, etc. Prompt shipments can be made from this warehouse to meet the requirements of the foundry trade of Minneapolis and St. Paul, as well as the northwest.

A Refining Cupola

A melting and refining cupola has been patented by Henry Johnson, Saxilby, England. The furnace may be of the ordinary type, with or without a receiver, but is specially formed at the bottom to hold a quantity of molten metal. A set of high pressure blast tuyeres is provided in the side walls, at the bottom of the bath, connected to an air compressor, the refining being accomplished by compressed air. Another set of tuyeres is provided at a higher level than the blast tuyeres, through which air or steam, at low pressure, is supplied to mix with the burning gases to support combustion.

Chilled Castings

By N. W. Shed

Question:—We are having considerable trouble with small castings which should be slightly chilled. There are 24 patterns on a card in rows of 12, and some of the castings are so deeply chilled that they cannot be machined, while others are only slightly chilled and are soft on the inside. We would like to know whether we can use a composition in the ladle which will aid us in obtaining a light chill on these castings and which will render the castings soft enough so that they can be drilled?

Answer:—You will experience some difficulty in regulating the chill of small castings. If the sulphur runs high the castings will be deeply chilled and if the sulphur is low the castings will be gray. By keeping the sulphur low the chill can be controlled by raising or lowering the silicon content. In the sample submitted, the sulphur is high and the iron shows a difference in chill with only 10 per cent difference in silicon. The practical method of overcoming the difficulty will be to make a hard mixture in the cupola and then raise the silicon in the ladle by adding ferro-silicon or high silicon metal. If you know the analysis of the metal, the proper amount of silicon metal to be added could be made by a simple calculation. The metal should be gated so that all the castings will have the same temperature when poured. Those poured cold will show a different chill from those poured hot.

Brake Shoe Mixture

By W. J. Keep

Question:—I would like a mixture for brake shoes for steam and electric roads.

Answer:—One of the leading eastern railways specifies that the casting should contain from 2.00 to 2.50 per cent silicon; 0.15 per cent sulphur; 0.70 per cent phosphorus, and 0.70 per cent manganese. The high sulphur is to give a chill without reducing the silicon below 2.00 per cent. The only objection to such high sulphur is a tendency for the chilled surface to crack when it becomes suddenly heated by the quick application of the brake. Very good results can be obtained by adding 1 or 2 per cent of spiegeleisen.

Trade Publications

LIFTING MAGNET.—In a six-page circular, recently issued, the Cutler-Hammer Clutch Co., Milwaukee, illustrates and briefly describes its line of lifting magnets.

ENGINES.—The B. F. Sturtevant Co., Hyde Park, Mass., in a 12-page circular, recently issued, illustrates and describes its line of horizontal center crank engines. They were originally designed for direct connection to the fans and electric generators built by this concern and embody many details of construction and design which, when modified for independent use, produce an economical and durable engine. They are built for both throttling and automatic regulation, for high, medium and low pressures.

TITANIUM IN IRON.—The Titanium Alloy Mfg. Co., Pittsburg, in a booklet recently issued, describes the treatment of iron with titanium. This alloy can be charged in the cupola or in the air furnace and thus obviates the necessity of adding the charge in the ladle. It may be used in this manner, however, if desired. The use of titanium in malleable iron, as well as chilled rolls and cast iron car wheels is explained at length. The results show a tremendous increase in strength and other desirable properties and the testimonial letters included, bear evidence of the good results accruing from the use of this alloy.

FOUNDRY EQUIPMENT. — The Whiting Foundry Equipment Co., Harvey, Ill., in catalog No. 77, recently issued, illustrates and briefly describes some of the recent installations made by this concern. These include a gray iron foundry for the General Electric Co., Pittsfield, Mass.; gray iron and pipe foundry for the Delaware, Lackawanna & Western Railroad Co., Scranton, Pa.; converter steel plant for the Vancouver Engineering Works, Vancouver, B. C.; malleable plant for the Malleable Iron Range Co., Beaver Dam, Wis.; gray iron foundry for the General Fire Extinguisher Co., Auburn, R. I.; gray iron and steel foundry for the Twin City Rapid Transit Co., St. Paul, Minn.; steel foundry for the Union Spring & Mfg. Co., New Kensington, Pa.; gray iron foundry for Pierce, Butler & Pierce Co., Syracuse, N. Y., as well as a gray iron foundry for the A. P. Smith Mfg. Co., Watsessing, N. J.

GENERAL INDUSTRIAL NOTES

The Wyandotte Foundry Co., Wyandotte, Mich., has been incorporated with a capital of $25,000.

P. F. Mork, Rogers Park, Ill., has secured a lease on the Slater & Marsden Co.'s foundry at Beloit, Wis., and will operate the plant.

Smith & Watson, Portland, Ore., have recently completed their new foundry and are now erecting a forge shop adjacent to their plant.

The E. N. Camp & Sons Co., Moreland, Ga., has been incorporated with a capital of $10,000 and will conduct a machine shop, iron and brass foundry.

The Southern Pacific Railway Co. has commenced work on the new iron and steel foundry which it will erect in connection with its shops in Sacramento, Cal.

The Dominion Stove & Foundry Co., Penetanguishene, Ont., has been incorporated with a capital of $250,000. The incorporators are Charles Beck, Dennis A. Lakey and Charles E. Wright.

The Dean Steam Pump Co., Holyoke, Mass., has commenced work on a new foundry building, this being the last of three large buildings which the company had planned for erection this year.

The Sanford-Day Iron Works, Knoxville, Tenn., expects to have its foundry in operation early in 1911. The new building will be 60 x 120 feet and equipped for the manufacture of car wheels.

The Fremont Stove Co., Fremont, O., has been incorporated with a capital of $35,000 to engage in the manufacture of stoves, ranges, etc. The incorporators are R. J. Christy, E. H. Zurhorst and Thos. H. Conway.

The Bedford Foundry & Machine Co., Bedford, Ind., has been incorporated with a capital of $100,000 to engage in the foundry and machinery business. The incorporators are E. A. Sohn, Charles Sohn and J. T. Krementz.

The Davis Safe & Lock Co. has just completed a new manufacturing plant at Kenton, Ore., which is of brick construction throughout, 420 feet long by 100 feet wide. In the building is a gray iron and brass foundry.

The Topeka Foundry & Machine Shop, Topeka, Kans., which was formerly owned by Roy Rohe, has been sold to M. Masching of St. Joseph, Mo., who will conduct the business under the name of the Topeka Foundry & Mfg. Co.

The American Weight & Foundry Co., Pittsburg, has been incorporated with a capital stock of $10,000. The incorporators are: David Carlin, James Thompson, B. E. Carlin, E. M. Brant and T. H. Hasson, all of Pittsburg.

The Stiles Mfg. Co., Parkersburg, W. Va., has been incorporated with a capital of $50,000 to operate a foundry. The incorporators are Albert M. Stiles, Samuel S. Stiles, Robert G. Stiles, Meigs J. Stiles and L. P. Butt, all of Parkersburg.

The Hildreth Mfg. Co., Lansing, Mich., has built a new foundry, 60 x 79 feet, and a new core room and casting cleaning department, 60 x 120 feet. New machinery including 10 tumbling barrels and several machine tools have been installed.

The West Side Foundry Co., Troy, N. Y., has completed several additions to its plant which have added considerably to its capacity. The main addition has been a new building for coremaking, which will permit an increase of one-third in the output.

The C. W. Raymond Co., Dayton, O., manufacturer of clay-working machinery, has completed the erection of a large plant at Bolander street and Broadway. The buildings are of brick and steel construction and the foundry is 105 x 120 feet, one and one-half stories in height.

The Wilkinson Foundry & Mfg. Co., Camden, N. J., has been incorporated with a capital of $200,000, to engage in the manufacture of automatic stokers, and to conduct a general jobbing foundry. The incorporators are: J. C. Laird, J. J. McGuirk and C. G. Wilfong, of Camden.

The R. C. Lynn Machine & Foundry Co., Inooza City, Miss., contemplates the removal of its plant to Graham, Texas. This concern operates a machine shop and also makes brass and iron castings. The change is due to the enterprise of the Texan city, which donates the site and pays all the expenses of removal.

The E. U. Scoville Co., Manlius, N. Y., has been incorporated with a capital stock of $20,000 to carry on a general iron and brass foundry business and to engage in the manufacture of hardware, stoves, etc. The incorporators are: Henry S. Whitney, Gilbert H. Tripp and Florence S. Lee, all of Manlius, N. Y.

The pattern shop and pattern storage building of the plant of Hillis & Sons, Ltd., Halifax, N. S., manufacturer of stoves and gray iron castings, destroyed by fire in May, has been rebuilt. The entire plant has been improved by the installation of new machinery and the capacity has been materially increased.

The Wilson Machine Co., Des Moines, Ia., has acquired the plant of the Crescent Furnace & Foundry Co., at South Sixth and Madison streets, and will reincorporate as the Wilson Foundry Co., with a capital stock of $10,000, which will enable the new management to more than double the present capacity of the foundry.

The Western Steel Corporation, Seattle, Wash., has completed and placed in operation, a gray iron foundry and pattern shop in connection with its steel plant at Irondale. The company is making its own castings, using the metal direct from the blast furnace, the work consisting of ingot molds and miscellaneous castings.

The Enterprise Iron & Brass Foundry, Joliet, Ill., has been organized by E. Stecker and E. J. Schahill, who have taken over the E. A. Holsworth foundry at Railroad and Shelby streets. Both are practical men, and were formerly manager and foreman, respectively, of the Bates Machine Co., where they were employed for 22 years.

The McKim Foundry & Machine Co., Lockport, N. Y., has been incorporated with $25,000 capital, and has taken over the McKim foundry on Green street. The capacity of the plant will be immediately increased by the erection of a large addition. The officers of the company are: President, Daniel G. McKim; vice president, Lawrence J. Hooker; secretary and treasurer, Harry Wood.

The G. A. Burrows Foundry Co. is the firm name of a new enterprise established at Ellwood City, Pa., by G. A. Burrows and C. E. Anderson, who were formerly connected with the Evans City Foundry Co., Evans City, Pa. The company has leased a brick building, 50 x 75 feet, which has been equipped for the manufacture of gray iron castings. Robert Irwin is president; G. A. Burrows, manager, and C. E. Anderson, foreman.

The Imperial Iron & Steel Co., Oklahoma City, Okla., has been incorporated with a capital stock of $80,000, and has taken over the business of the Gainsville Iron Works, Gainsville, Texas. Two buildings have been erected, 80 x 200 feet and 100 x 150 feet, respectively. The officers of the company are Mora C. Clark, president; R. H. Dorsey, vice president and general manager, and A. T. Snoddy, secretary and treasurer. G. Baxter Rogers is superintendent.

The Marseilles Co., East Moline, Ill., is now moving into its new plant, which will shortly be placed in operation. The site covers 28 acres and the main building is four stories high, 80 x 552 feet. The foundry is 80 x 468 feet. A one story building of corrugated steel construction, 80 x 550 feet, will house the blacksmith shop, iron and hardware departments. The warehouse for the finished product is 100 x 600 feet, one story high. Electric power will be used throughout the plant.

The Lunkenheimer Co., Cincinnati, has nearly completed the five-story, reinforced concrete addition to its plant at Lawnway avenue and Tremont street and has already moved its brass foundry to the top floor of the new building. The erection of this building has been carried out under the company's supervision, and not by contract, and has proceeded slowly as many new and novel ideas have been developed, tested and incorporated in its construction, one of which is a metal window sash and frame, which has proved so satisfactory that the company contemplates engaging in its manufacture. Another interesting feature is the sand mixing apparatus on the fourth floor. This device takes the form of a series of long troughs, to which are imparted a longitudinal reciprocating movement, together with a vibratory motion, which mixes and cools the sand and discharges it to conveyors which return it to the molding floors above. The sand is fed to the mixers by gravity, through longitudinal openings in the casting floors, which are equipped with deflectors in the form of metal doors that direct and regulate the fall of sand, according to the capacity of the mixers. The foundry, with its attendant operations, will occupy the fourth and fifth floors. Other floors will be devoted to the machine shop, etc., which departments will soon occupy their new quarters, and before Jan. 1 the new shop is expected to be in full operation.

The M. Rumely Co., manufacturer of agricultural machinery, La Porte, Ind., is now installing the equipment in its new gray iron foundry, which will have a capacity of 100 tons daily. The foundry building consists of three bays and a storage shed. The middle bay is 60 feet wide and the two side bays are 80 feet, each. The storage shed is 75 x 500 feet, a length of 300 feet of this building being covered. Four cupolas, two of which are 60 inches and the other two 48 inches, inside the lining, are being placed at one end of the center bay to be used alternately, two on one day and two the following day. Fifty tons of semi-steel will be melted in the one cupola and 50 tons gray iron in the other. The blast will be put on at about 11 o'clock in the morning and continuous melting will be practised as nearly as possible. Between the floor and the charging platform is a mezzanine floor, on which the shower baths, lockers, blowers, motors, heating system, etc., are located. The center bay will be served by a 10-ton crane with a 3-ton auxiliary, while the side bays, where all the lighter work will

be done, will be served by a number of 2 and 3-ton electric cranes. The storage shed will be served by a 5-ton crane equipped with a 42-inch magnet for handling iron and scrap. The exhaust type of tumbling mills will be used exclusively. Six core ovens are being erected outside of the building, the doors forming a part of the foundry wall. The plant was designed by O. B. Zimmerman, engineer, and G. W. Gelderman, foundry superintendent.

New Construction.

The Pneumatic Gate Co., Chicago, will erect a foundry.

The West Allis Iron Works Co., Milwaukee, will erect a foundry.

Bramley Brothers, North Tonawanda, N. Y., are considering plans for the erection of an iron foundry.

The Canadian Westinghouse Co., Hamilton, Ont., is building an extension to its foundry at a cost of $18,000.

Brey, Knause & Co., Allentown, Pa., will erect a foundry for the manufacture of iron and brass castings.

The Reddin Iron Works, Syracuse, N. Y., has completed plans for the erection of a foundry, 77 x 148 feet.

The Northwestern Steel & Iron Works, Eau Claire, Wis., has broken ground for the erection of a large foundry.

The Coeur d'Alene Foundry, Wallace, Idaho, which was recently destroyed by fire, has been rebuilt on a larger scale.

The H. B. Smith Co., Westfield, Mass., manufacturer of radiators, boilers, etc., will build an addition to its foundry.

The Baker-Vawter Co., Chicago, is having plans prepared for a foundry, which will be established at Benton Harbor, Mich.

The Wiard Plow Co., Batavia, N. Y., has completed plans for a foundry addition of brick and steel construction, 60 x 70 feet.

The Niles Tool Works, Hamilton, O., will erect a foundry, 432 x 180 feet, and the present casting plant will be converted into an erecting shop.

The Davis-Price Foundry & Machine Co., New Cumberland, W. Va., will build a new plant at that place to replace the one recently destroyed by fire.

The Sumner Iron Works, Everett, Wash., is erecting a new plant in Burnaby, B. C., which will consist of a foundry, boiler shop and three erecting shops.

The E. H. Bardes Range & Foundry Co., Cincinnati, has commenced work on an addition to its plant, 35 x 35 feet, which will be used as a pattern storage room.

F. E. Myers & Bro., Ashland, O., have awarded the contract for the erection of their new foundry. The building will be of brick and steel, entirely fireproof, 140 x 250 feet, and will cost $39,200.

The Geiser Mfg. Co., Waynesboro, Pa., having found that it was not feasible to enlarge its old foundry, has acquired a site at Broad and Fourth streets, on which it is erecting a larger shop, to be equipped with all modern facilities.

The Jones-Everett Machine Co., Ardmore, Okla., will install a foundry in connection with its machine shop. The new concern will be known as the Ardmore Foundry Co. A 36-inch cupola has been purchased and work on the buildings has commenced.

The Malleable Foundry Co., Benton Harbor, Mich., is enlarging its plant by the erection of a building, 60 x 90 feet, to be used as a foundry and annealing room. Three large annealing ovens will be installed, which will more than double the present capacity.

The Cleveland Foundry Co., Cleveland, has purchased a 12-acre tract on Ivanhoe road, in the new manufacturing district along the Nickel Plate railroad, on which it plans to erect a new plant, which will be eventually as large as the present works, where it has no further room for expansion.

The Superior Stove Works, Chicago, will rebuild its present plant, making it a four-story structure, 100 x 75 feet. The foundry will be located on the top floor. All of the departments will be equipped with the most modern labor-saving appliances. The cost of the building will be about $45,000.

The Pennsylvania General Electric Co., a subsidiary of the General Electric Co., Schenectady, is erecting at Erie, Pa., three foundries and a machine shop. The gray iron foundry will be 450 x 800 feet, and the two other casting shops will be 200 x 400 feet each. The machine shop will be 161 x 400 feet.

The Grand Trunk Pacific Railway Co. is building shops at Winnipeg on a very large scale. Several structures have been erected in the past 14 months and contracts are yet to be let for 13 other buildings. The gray iron foundry is of steel frame construction, 200 x 250 feet. Other shops being erected include a locomotive shop, frog and track shop, power plant, etc.

The American Seeding Machine Co., Springfield, O., will erect a reinforced concrete foundry building, 105 x 200 feet, in the rear of the foundry purchased by the company last spring. A concrete tunnel will also be constructed to lead from the main building to the branch foundries, to enable the castings to be transferred to the factory without being impeded by outside traffic.

The Illinois Cast Iron Pipe & Foundry Co., Chicago, which was recently incorporated with a capital of $2,000, has increased this amount to $75,000 and will issue $250,000 in 6 per cent bonds. The company has purchased 15 acres of land at Chicago Heights, on which to erect a plant. The main building will be 132 x 480 feet, and will be equipped especially for the manufacture of cast iron pipe and fittings. The capacity of the plant will approximate 40,000 tons annually. Contracts for equipment are now being awarded.

The Seymour Iron Foundry, Seymour, Conn., will erect a new foundry on a site just purchased on North Main street. The main building will be of reinforced concrete and brick construction, 50 x 200 feet. The cupolas and coreroom will be in an ell, 15 x 50 feet. Ample light will be provided, the north end being composed practically entirely of windows, while skylights will be placed in the roof. The foundry will have two cupolas, one for the regular line of machine castings, the other for special work. Three cranes will be provided, and an industrial railway will serve the entire plant. An office building, 30 x 40 feet, will also provide ample room for pattern storage.

The Damascus Crucible Steel Co., New Brighton, Pa., is enlarging its plant by the erection of three buildings, the largest of which, 45 x 205 feet, will be used as a steel foundry and casting cleaning department, and will contain melting furnaces and gas producers. A second building, 48 x 160 feet, will contain heating and annealing furnaces and tools used in the manufacture of tool steel. A lean-to will be attached to the side of one of these buildings, paralleling the railroad track and will be divided into storage bins for coal, sand, crucibles and scrap. The third additional building, 20 x 40 feet, will be used for the power plant and machine shop. The officers of the company are Charles Capper, president and general manager, and C. H. Capper, secretary and treasurer.

The International Harvester Co., Chicago, advises that the new foundry which is being constructed at Milwaukee, is to be of steel, brick and concrete construction, covering a ground area of 190 x 780 feet. The foundry building proper is 780 feet long and 185 feet wide. It has a gallery floor 665 x 74 feet and the total molding floor area, not including the space used for core ovens and cleaning rooms is about 150,000 square feet. Mezzanine floors containing 7,300 square feet of space are provided for toilet rooms, lockers and sanitary arrangements for the men. The sand, coke and foundry supplies will be stored in a substantial building which will be built in direct-connection with the main foundry structure. The main foundry room is provided with 20-ton traveling cranes, and a complete telpherage system will be installed on the gallery floor, and underneath the same. A steel, saw-tooth roof is used with a concrete surface, covered with a standard gravel coating. Continuous steel window sash is employed both in the saw-tooth lanterns and sides of the building, providing ample light and ventilation. Raw material will be brought from the storage yard and railroad cars by gantry cranes of 75-foot span, running the full length of the foundry; the cupolas are also supplied from this crane. Heavy castings are also handled by gantry cranes on the opposite side of the building. These cranes have a span of 85 feet and a run of 418 feet. A reinforced concrete pattern storage building, 48 x 168 feet, two stories high, adjoins the main foundry. The equipment of this plant will be unusually complete, including a large number of molding machines. The engineering work on the building is being handled by the Arnold Co., Chicago.

Among the Brass Foundries.

The Routh Solder Co., Newark, N. J., has been incorporated with a capital stock of $50,000 and will engage in the manufacture of soft and other solders. The incorporators are Frederick N. Gleason, M. A. and K. E. Routh.

The Reed & Prince Mfg. Co., Worcester, Mass., manufacturer of rivets, wood and machine screws, etc., states that the brass foundry, recently added to its plant, will be used for making hardware specialties in brass and bronze.

The Casey Aluminum Foundry Co., Chicago, has been incorporated for $20,000 to provide additional working capital to carry on the business which has been established several years. The incorporators are Edward F. Casey, Jacob Sandeoritz and Charles Weinfeld.

The Pittsburg Journal Bearing Co., Pittsburg, has been incorporated with a capital stock of $250,000 to engage in the manufacture of journal bearings for railroad cars, etc. The incorporators are: D. H. Stewart, William Corner, Braddock, Pa., and James L. Adams, Coraopolis, Pa.

The Mattoon Machine & Foundry Co., Mattoon, Ill., has been incorporated with a capital of $25,000 to engage in the manufacture of brass valves. In addition to the valve specialty, the company will engage in general foundry and machine business, and contemplates the erection of a foundry.

The Light Mfg. & Foundry Co., Pottstown, Pa., has recently purchased the property opposite its present plant, on which a new foundry will be erected, 60 x 150 feet. This concern specializes in castings of aluminum, manganese bronze and bearing alloys for automobile, power boat and aerial construction.

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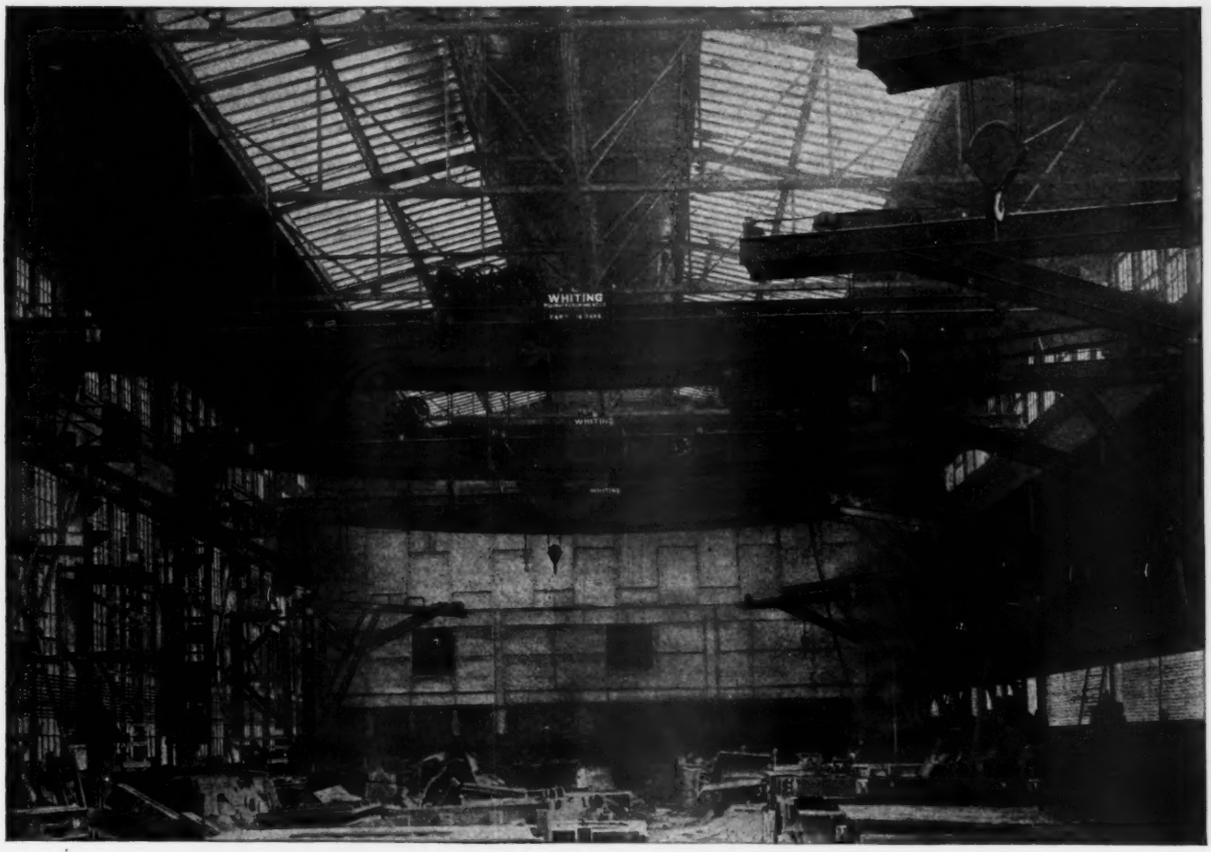

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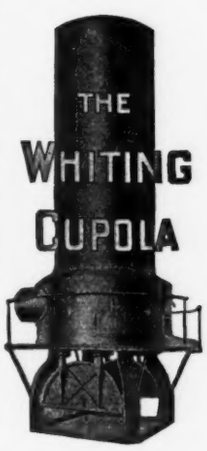

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